RENDERING

The Invisible Industry

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RENDERING

The Invisible Industry

by

Frank Burnham

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A WORD OF EXPLANATION AND ACKNOWLEDGEMENT

When I was asked to create RENDER Magazine some seven years ago and produced the first issue, a number of renderers asked how I expected to find a source of interesting and timely copy to last beyond just a few issues. As a reporter, I knew that with each passing year this industry would generate even more interesting and informative material.

I recognized that it was urgent for the rendering industry to inform the general public about its contributions to society and to correct a number of major areas of misinformation. Most appalling, however, was finding — during a literature search — that not a single book about the rendering industry was available, even in such huge libraries as those maintained by the City of Los Angeles and the University of California.

At that time I made up my mind such a book must be written. This is that book — the first, as far as I can determine, published in the United States about an industry that has remained almost invisible for more than 150 years quietly doing its thing on the back streets of America.

Although it is historically accurate, this book is not representative of a history in the academic context. Although technically accurate, it cannot be considered by any stretch of the imagination a handbook for the industry. It is, however, a reasonably comprehensive overview of an industry which today contributes more than $2 billion to the GNP and which makes major contributions to present-day society. It also represents a logical jumping-off place for future scholars and writers who may be motivated to give this industry the editorial attention it deserves.

Without the support and confidence of the Pacific Coast Renderers Association and particularly Dick Ellis, Louis Ottone, Bill O'Donnell, Ray Kelly and George Cator, it could not have been accomplished. Without the help of Ed Ricci of Darling-Delaware, Chet Twiss of Corenco, Bob Peterson and Bob Werner of the National Renderers Association, in acquiring historical photography, it would not be complete. Without the help of our typist, Mary Jewett, who prepared the manuscript; my wife, Hazel, who proofread it and compiled the index; and our granddaughter, Tina, who assisted with the index, it would not have been completed. And without the hard, often dirty, work of renderers across the country for the better part of two centuries, there would have been nothing to write about.

Frank Burnham
Riverside, California
June 22, 1978

ABOUT THIS BOOK

Some time ago a group of West Coast renderers were discussing the updating of a local periodical which they had been publishing for several years. During the course of time this publication had become somewhat stereotyped and was not reflecting an accurate image of the industry.

In the discussions that followed, a set of parameters and objectives were set forth that reflected the collective interests of those involved. The final decision called for a magazine which would not only project the positive aspects of a fascinating and viable industry to those not familiar with our trade but also act as a medium for exchanging information among the members of that industry.

This was a time when emphasis on ecology was just beginning. Government agencies were starting to promulgate new and more stringent regulations on standards for clean air and clean water, feed additives, processing chemicals and the myriad of facets facing American business.

Renderers, in short, felt it was time to sponsor a singular view in emphasizing their contribution to the national and world economies. After all, this was the original recycling industry.

While interviewing potential editors and publishers it quickly became apparent here was truly an invisible industry. Few of those under consideration knew of the industry, much less of the services performed or the products produced. Research on their part was of little help. No mention of rendering appeared in any of the leading encyclopedias and a definitive book on the subject could not be found in any major public library.

Despite these handicaps the magazine ultimately was published and currently is being distributed internationally. However, the situation cited above still exists. The unanswered question remains: How so many people can be so completely unaware of an industry that in so many ways touches their daily lives.

This book then is an outgrowth of this concern. It is a combination of the recollections of some of the pioneers of the industry, interviews with current leaders in the business, a smattering of technical data, and a general overview of the construction of the trade as it exists today.

There has been no attempt to establish this book as the final and complete history of rendering, a definitive technical handbook, or even as an infallible guide to a complex business. The author leaves this to those we hope may follow.

To paraphrase the late Dr. Robert Gannon of Fordham University, "all true progress is ninety per cent heirlooms and memories — an accumulation of small but precious deposits left by the countless generations that have gone before us. Only very proud or very ignorant people imagine that we can begin everything all over again every day . . . and invent a new alphabet, a new multiplication table, a new code of laws, or a new industry."

This then is a general survey with a deep, personal recognition of those who have preceded us. Without them the industry would have to start anew each day.

Objectively, we hope to gain a large number of interested readers. Hopefully, among these readers we will stimulate the thinking of a few to build upon these ideas with additional research and subsequent publication. Only then, will rendering emerge from its cloak of anonymity and be recognized as it most certainly should as a vital and important link in the food chain, its contribution to the world economy fully realized.

Robert N. Peterson
Hollister, California

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AN INDUSTRY IS BORN 1

Plinius Secundus, otherwise known as "Pliny the Elder," Roman soldier, scholar, historian and naturalist, was a curious man. His curiosity knew no bounds as his "Natural History" testifies. That curiosity embraced the birds of the air, the fish of the sea, the animals and plant life of the earth, the sky and stars, the attitudes and activity of man. It is from his prolific pen that man's first written record of a process that gave birth to today's billion-dollar rendering industry is found.

Pliny reported a cleansing compound prepared from goat's tallow and wood ashes and therein set to book the earliest record of soap and, ergo, the first record of rendering—the melting down of animal fat to obtain tallow.

Historians aren't certain whether the Romans adopted their tallow-making process from the chance discoveries of wandering Bedouins or from the Celts who are known to have made "saipo," also from boiling animal fats and plant ashes together. Pliny was unable to tell us more. His curiosity got the better of him. In 79 AD he went to investigate the eruption of Vesuvius and fell victim to its asphyxiating gases. There is, however, evidence that soap was fairly well known to the Romans of his day despite the fact that some 1,800 years would elapse before it would come into wide use.

The Greek physician, Galen (130 to 200 AD) described soap both as a means of cleansing the body and as a medicant, and another physician, Theodorus Priscianus (385 AD) described its use as a shampoo. He also was the first to record the trade of "saponarius" or soap boiler.

In about 800 AD, Jabir ibn Hayyan, an Arab chemist, wrote repeatedly of soap. Known as the "father of alchemy," Hayyan spoke of soap as an effective means of cleaning.

Notwithstanding an apparent general knowledge of soap—at least among scholars, scientists and physicians—it seems its use was limited to cleaning hair and body. As a laundry product, it did not come into general use until the mid 1800s. From the time of the Roman Empire through even the early part of the nineteenth century, "fulling" remained the principle method of laundering.

In ancient Rome, the fullers—next to the bakers—seemed to have the largest group of tradesmen. The Roman "fullonica," or laundry, operated using what is now known as "Fuller's earth." This greenish, clay-like material—which absorbs grease from cloth—was the fuller's chief tool. With this, and with potash obtained from burnt wood ash and carbonate of soda, the fullonica would wash, beat, dry and whiten the cloth with sulphur fumes.

Even as late as the 1830's, the same methods were being used in English fulleries. They used Fuller's earth, lye and ammonia, as the Greeks and Romans did—working without soap, because soap was still an expensive and highly taxed luxury.

Following the decline and fall of Rome, historians find comparatively little reference to the use of soap. Its manufacture and popular use may have been revived in Germany, but it appears to have been developed largely in Italy, France and England.

In the Middle Ages, Marseilles was the center of the growing, young industry of soap-making. But the manufacturing families of the famous "Marseilles Soap" managed to keep their process secret for many generations. Even the offer of a generous prize by the Academy of Marseilles in 1769 for the best paper on the manufacturing of soap, failed to draw out the secret process.

Indirectly, however, the "contest" did succeed when—five years after the initial announcement—a paper on soap-making was submitted. But it was reportedly the work of a layman to whom the secret of details of manufacture had been described by a friendly member of the trade.

It is surprising that the simple manufacturing process of the burgeoning soap-making industry could have been kept secret so long. Just prior to the French Revolution, soap production in Marseilles had reached 3,500 tons per year from some 34 factories.

Marseilles developed a considerable export business of its soap—chiefly to America. The industry in France received still greater impetus by LeBlanc's discovery at the end of the eighteenth century. This was a process for making soda from brine.

New formulas, blending fat and oil stocks from tallow and seed oils, also helped speed development of the soap-making industry. The research of the French chemist, Chevreul, was an important factor in advancing the industry—particularly his experiments in 1823, showing soponification to be the chemical process of splitting fat into the alkali salt of fatty acids and glycerine.

In England soap was first made in Bristol toward the end of the twelfth century, but the center of the industry soon developed in Cheapside, a suburb of London. But there was nothing cheap about soap in England from the twelfth and well into the nineteenth century.

Soap makers were required to pay a duty on every ton produced. This tax, of course, was passed on to the consumer. Following the Napoleonic Wars of the early nineteenth century, the tax on soap rose to as high as three pence on every pound produced.

Soap boiling pans were fitted with lids, which could be locked at night by the tax collector to prevent "tax-free" soapmaking under the cover of darkness. In spite of these handicaps, the use of soap—and its use of tallow—continued to spread in England. Queen Elizabeth, in the latter sixteenth century, is reported to have indulged in a hot bath with "sope" once a month.

Finally, in 1853 under the government of Prime Minister Gladstone, the tax on soap manufacture was abolished, making the product available to a much larger market.

Also playing its part in the early development of the rendering industry was candle-making. Starting with primitive tallow "dips" and rushlights—the pith of rushes soaked in household grease—candle-making became a widespread house industry.

In the thirteenth century in Paris one of the strongest guilds was that of the traveling candle-makers who went from house to house practicing

their trade. Later primitive candle "factories"—similar to the soap-makers—developed with a simple version of the modern-day assembly line utilized for boiling and drawing, molding and finishing the candles.

In his three-volume history of London's Worshipful Company of Tallow Chandlers, Randall Monier-Williams gives us a greater insight into the development of rendering as an industry. Also, it is important to understand that although soap ultimately became the principle product made from tallow, soap essentially was a by-product until the latter part of the nineteenth century. The main product was candles. And the making of candles was the business of London's tallow chandlers.

Even in those days the very finest of candles were made from bees wax, but these candles were only for the wealthy. And, even then, it appears that tallow candles were generally used except on special occasions and in the master's quarters. According to Monier-Williams, the tallow candles were called "peric or peris"candles with a distinction drawn between them and bees wax candles. Peric candles, he reports, were part of the regular service for all in the royal household except for the King's chamber.

While most of Monier-Williams' work is devoted to the establishment of the tallow chandler's trade as a recognized craft guild and the involvement of the various craft guilds in London politics over some 600 years, the author does provide a graphic picture of the process itself.

"The common candle," he writes, "known to our ancestors as the tallow 'dip' was a simple device for providing a little artificial illumination where it was wanted after dark. At its very best it would not light every corner of the room, but, even for the well-to-do, man-made light in the home was for centuries considered something of a luxury. That the candle was portable was its great attraction. In the winter, when the nights were long, and the need 'to illumine a place in the absence of the sun' was greatest, the fire gave light as well as heat, but 'the place' was constant.

"The origin of this cunning contrivance is lost in antiquity. It is indeed a matter for conjecture as to which came first—the lamp in its rudimentary form of an open saucer with a fibrous substance, which we call a wick, immersed in oil, or the candle with its wick encased in solid fat. The process by which light is produced, from the combustion of a candle or a lamp, is essentially the same, with this difference, that heat, through the wick, must first render the solid matter of the candle fluid.

"The method of making candles by 'dipping' goes back at least to the days of the Romans. They had the true candle with tallow as its combustible material surrounding a flax or cotton wick, as well as the torch, in which the fibrous matter, coated with pitch, was predominant.

"The dipping process was also used for the homemade rushlight, consisting of a reed stripped to the pith and plunged in household grease or oil, which long continued in England as the cheapest means of lighting.

"A superior type of tallow candle was made by moulding; a method said to have been introduced by a French nobleman in the fifteenth century, but moulds were not greatly used in this country until the candle-making machines of the nineteenth century were invented.

"Candles for the rich and for religious purposes were made of bees wax, an entirely separate industry. Neither moulding nor dipping was considered quite suitable for these candles, the usual method being to ladle

melted wax over the wick, and after the candle had cooled, to roll it on a smooth surface.

"Tallow, by definition, is the solid oil or fat of ruminant animals, but commercially it is obtained almost entirely from oxen and sheep. According to an early eighteenth century writer, 'a tallow candle to be good, must be half Sheep's Tallow, and half Cows; that of Hogs making 'em gutter, give an ill smell, and a thick black smoak.' A century later we are told that for moulded candles, sheep-tallow is used with a certain proportion of the best kind of ox-tallow, that which is yielded by sheep-fat being brighter and of firmer texture than ox-tallow, which is employed with inferior pieces of sheep tallow for dips. From other accounts it seems probable, however, that this writer failed to do the common candle justice.

"For information on the changing methods of candle manufacture employed from time to time in the past, we must turn mainly to the encyclopedias, of which the earliest, for our purpose, is Ephraim Chambers' Cyclopaedia of 1728.

"The first task was to prepare the material, which could either be performed by a 'melter' or by the tallow-chandler himself. It was known as 'rendering,' a process which the author of the article on 'Candle' in Chambers' most interesting and valuable publication describes in some detail.

"Briefly, he tells us that 'the tallows'—referring to the rough fat from the butcher—were cut or hacked into pieces and thrown into a pot or boiler. When perfectly melted and skimmed, a certain quantity of water was thrown in which served to precipitate to the bottom of the vessel the impurities of the tallow that had escaped the skimmer. The melted tallow was then emptied through a sieve into a tub, having a tap for letting it out as occasion required, and was ready for use after standing for three hours. In an article on 'Chandlery' in the London Encyclopaedia published a century later, we are told that tallow from which all impurities had been removed was sometimes stowed away in tubs for future use, some 'superior makers' preferring to mix tallow after a twelve months' age with that which is newly rendered.

As the years passed, this rather primitive method of rendering was improved upon by employing two separate vessels. This is clear from Charles Tomlinson's Cyclopaedia of Useful Arts and Manufacturers published soon after the Great Exhibition of 1851. The dangerous practice of melting tallow in an open copper exposed to the direct action of the fire continued, it seems, for many years. But now the membranous matters on the surface, after fusing for some time, were removed, and the melted tallow was passed through a sieve into another copper where it was washed with a quantity of boiling water. The impurities settled down with the water at the bottom of the copper, and the purified tallow was lifted out in buckets of tinned iron into a tub where it cooled and was then ready for use.

"From this author and the earlier writer in the London Encyclopaedia of 1829 we learn that the membranous matters were subjected to the operation of a strong iron press, and the cake that was left was called greaves, or cracklings, with which dogs were fed and (according to the earlier writer) a large portion of the ducks that supplied the London

Markets."

Monier-Williams later adds that "until the introduction of the new product known as 'Spermaceti'—derived from the oil in the head cavity of the sperm whale—about the year 1750 the only candle-making materials were tallow and bees wax. Because of its clear steady flame Spermaceti became the standard measure for artificial light, the term 'one candle power' being based on the light given by a pure spermaceti candle weighing one-sixth of a pound and burning 120 grains an hour.

"Tallow and bees wax remained nevertheless the chief candle-making materials for many years. That this was still so in 1829 was recognized in the article in the London Encyclopaedia, but by this date the age-long use of the tallow candle was steadily declining. A number of substitutes had made their way onto the London market. Palm oil in particular was much in vogue in the 1850's."

For the tallow chandler (as a candle maker, that is), his era came to an end in the 1850's with the advent of paraffin wax. By this time, however, soap making had become a growing industry on its own and a Frenchman, Michel Eugene Chevreul, had demonstrated that fats were, in fact, fatty acids and glycerine. He successfully separated the fatty acids from the glycerine, producing stearic acid. Chevreul, thus, established the groundwork for today's fat splitting industry and opening up new, potential markets for animal fats.

The market for tallow had shifted from raw material for candles, then the major source of illumination, to soap and this market was to consume the lion's share of the world's tallow for the better part of another century, in fact, until the advent of the petroleum-based, synthetic detergent of today.

As the wheels of industrial revolution began to turn, rendering and the manufacturing of soap progressed together in the United States. Following the Civil War, domestic consumption of soap rose tremendously. The first well-known brand of soap was "German Detersive"—a cut pound-bar wrapped by the manufacturer or supplied to the retailer with the wrappers left loose in the case. The bars were then wrapped as sales were made. This was a considerable improvement over the usual method of just supplying large blocks to the storekeeper who would then have to cut off portions of the size wanted by the shopper.

Rendering is a process developed over the better part of 1,800 years as a direct adjunct of the candle making and the soap industries. And during this period tallow was derived primarily from the fat of sheep and goats. Pork fat, while used in soap making, made very poor candles. Obviously, as the world population of cattle grew, more and more beef tallow was produced but it took this country with its voracious appetite for beef and the explosive development of the cattle industry in the latter part of the 1800's (and on into this century) to propel the renderer into his present place of prominence.

There is one area of the United States, however, where the growth of the cattle industry had little to do with beef as a food. In California, cattle were raised for their hides and tallow. While a relatively small amount of beef was consumed, most of it went to the coyotes and other wild animals.

In his "Cow Hides to Golden Fleece," Reuben L. Underhill recounts early California history as derived from unpublished correspondence with

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Thomas Oliver Larkin, the so-called Yankee supersalesman who arrived on the California shores in 1832 and became a millionaire trading in hides and tallow, sea otter and beaver skins. Whalers of the early 1830's told "incredible tales of the Californios with enormous herds of cattle valued only for their hides and tallow." Taking stock of those tales, Larkin—who later became the U.S. Consul General to the then foreign state of California—went to the West to make his fortune.

Robert C. Cleland in his March of Industry quotes Larkin, on the eve of the U.S. occupation of California in 1846, as saying the province was annually exporting 80,000 hides and 1,500,000 pounds of tallow. The exports for the most part went to Boston with many of the hides returning to California in the form of shoes and leather products.

During the Mexican-Spanish regime, Cleland reports, California was to all extents and purposes the land of a single occupation—stock raising—its chief source of wealth. Trading hides and tallow to foreign vessels gave California nearly all of the manufactured articles and most of the luxuries it could not produce. Hides and tallow were its only marketable products and were commonly exchanged at greatly enhanced prices instead of being sold. In this economy dominated by the production of hides and tallow, the income of the rancher was ascertained from the number of cattle he held. Beef was of a nominal value. A small part was salted down and used as a staple item in the diet but for the most part it remained a waste product and was left on the range. The hide sold for $2 and with the tallow—two or three "arrobas" (25 pounds to the arroba at $1.50 the arroba)—netted the owner five dollars or so.

By the 1850's, a steer was worth about $12 to $13 yielding about 50 pounds of dried beef, 200 pounds of tallow and the hide, according to Cleland. The cost of slaughtering, skinning and "trying out" the tallow came to about $4.50. Dried beef was selling for only 20 cents a pound, however, while tallow was bringing 48 cents a pound. Some of it was made into soap locally, but the largest share of California's tallow went back East also to be made into soap.

Cleland's second book on early California, "Cattle on a Thousand Hills," gives us another look at soap-making in those early days. Reporting on the process as it was used on Isaac Williams' Rancho Chino, Cleland said: ". . . over a durance was placed a boiler about 10 feet deep and the same size in diameter, the upper part was made of wood. This was filled with tallow and the fattest of the meat. A little water was also poured into it and then the whole was tried out after which the grease was dipped into a box about 10 to 12 feet square. The meat was then thrown away. Mineral earth was leached like ashes, the lye obtained put with the grease and boiled into soap."

The best quality soap, Cleland said, "was almost as white as snow."

Development of the cattle industry in California was quite different from that taking place in Texas and throughout mid-America. Certainly in the earliest days hides and tallow were the primary products. But as the nation, the eastern part at least, became involved in the industrial revolution; immigrants from abroad kept pouring into the country; and city-dwellers developed a greater taste for beef. Actually, the advent of commercial meat packing in the United States predated the Declaration of Independence by more than 100 years. William Pynchon of Boston

became the first commercial meat packer in America in 1662 and by 1756 Boston had become the slaughter center for most of the Northeast. Still, most slaughter was done on the farm. Thus, most tallow-making also was done on the farm.

The nation's first combined slaughter and meat packing operation was established in 1838 at Alton, Ill., and in 1865 the Chicago Stockyard became the nation's leading livestock market. During the mid-1850's, the railroads drove deeper into the nation's heartland. With them came the era of the great cattle drives from the plains of Texas to the railheads in Kansas and Oklahoma. The Civil War came and went. G. H. Hammond of Detroit, a meat packer, came up with the idea of a refrigerated freight car and Gustavus Swift brought it to practical reality. As cattle slaughter made the transition from the farm and ranch to the city, so did the rendering operation. However, to a great extent it continued to exist in concert with soap manufacturing. It wasn't until the renderer discovered it was more profitable and less work to produce tallow and sell it to the soap manufacturer than to deal with the multiple problems of making the tallow, turning it into soap and then selling the soap, that the industry as we know it today came into being.

In a way, the history of the U.S. rendering industry can be found in microcosm in the history of many of today's successful rendering companies. One of those is Corenco, formerly the Consolidated Rendering Co. It ranks among the nation's largest renderers.

H. W. Heath, son of a slaughterhouse owner and operator in Groton, Vt., grew up with the business and by the latter part of the 1800's he had developed some of his own ideas about the relationship between cattle slaughter, meat packing and rendering. By 1883, he was managing a facility for Gustavus and Edwin Swift in Manchester, N.H., and under his stewardship the business flourished. Heath's approach (from the Corenco history) is typical of what was going on in many areas of the nation during that period.

Western dressed beef now having become firmly established with the consuming public as to its superior quality compared with native beef, and the distribution of same stabilized and to be depended on, the old-time country slaughter houses were gradually going out of business. Most of these old-time slaughter houses rendered a small quantity of tallow incidental to their principal business of slaughtering native cattle. Their methods were crude and the operating conditions such as to cause much complaint by the public.

It was in the course of these changing conditions that Heath visualized the possibilities of centralized rendering units, and persistently endeavored to interest the Swifts personally to furnish the money necessary to engage in this new venture, with the view of building plants at various locations. In this he was successful, and ever since the Swifts' interest in our business continued a personal one.

The first rendering unit established was located at Manchester, N.H., and was personally managed by H. W. Heath.

The original building was erected by the Swifts for the purpose of conducting a slaughtering business, and they averaged to kill a car of Western hogs each working day for several years. They also slaughtered and dressed hogs raised by individuals in the city and vicinity that were

brought in. The hogs after being dressed at the plant were put in the cooler at the Franklin and Cedar Streets building, from which location the marketing was done.

As the Swifts became interested in larger packing plants in the East, slaughtering was discontinued at Manchester, and in December 1889 the nucleus of a rendering business was established. In the years prior thereto, in addition to the rendering done at country slaughter houses, there also were small rendering establishments at various locations in the New England States, where the population was of sufficient size to warrant.

Generally the buildings were hardly more than wind-breaks, and there was a great deal of waste in the processing; tank water ran down the brooks, tankage was air dried on platforms outside the buildings, and sold by the barrel for chicken feed. The limit of time when such plants could continue to operate under the conditions that prevailed was fast approaching a crisis, as some of the plants were located in what was soon to be the heart of cities or sizable towns.

The business increased gradually and although the volume was small at the beginning, from time to time stations were established at Nashua, Concord and Laconia, and in the course of a few years was 'picking up' throughout central New Hampshire, and also branching out into the hide and skin business.

The business now being fairly well organized in the Manchester territory, and the financial results reasonably encouraging, other locations were under consideration in which to build and expand.

In 1893 consideration was given to entering the rendering business in the State of Maine with a plant to be located in Portland.

In this year a financial panic was well under way, unemployment became quite general throughout the country, and these conditions continued through to the year 1896, with widespread bank failures in the meantime. It is therefore well for us to reflect upon the fact that in spite of these adverse conditions, the founders of our business had the courage and capacity to provide the money with which to expand. They looked beyond the discouraging conditions then prevailing, and went ahead with their plans to build a plant at Portland, as well as having other locations definitely in view.

As in the case of the development at Manchester, branches were gradually established as far north as Rumford Falls, Maine, and as far east as Bangor, with others located in the principal central cities of Maine. It must be remembered that in those days transportation was very slow, the raw material was picked up by teams and brought into the 'stations' and then shipped to the plant by railroad. It was not unusual for material collected on a Saturday even from so short a distance as 25 miles away, not to arrive at the plant until the early afternoon of the following Monday.

The chronicle of Peterson Manufacturing Co., (now a wholly-owned subsidiary of Kane-Miller Inc.) depicts the growth of another major renderer entering the industry from a different direction.

In the 1890's, a Berkeley, Calif., hog raiser began collecting waste suet and bone from butcher shops in the growing San Francisco Bay area to supplement the diet of his animals. In a huge iron kettle in the kitchen stove, his wife cooked the scraps, skimming off the liquid fat that rose to

the top of the kettle and storing it in drums. The residue, or cracklings as they were known, were used in the hog rations. When enough fat, now solidified into tallow, had accumulated it was carted down to the Port of Oakland, put aboard ships bound around Cape Horn to the East Coast and the plants that converted the tallow into soap.

The man was Nels P. Peterson, Sr., and the company he founded in the family kitchen, the Peterson Tallow Co.

Shortly after the turn of the century, Nels Peterson moved his operation from the family kitchen to Emeryville, Calif., a city now considered a part of the Greater Oakland complex of East Bay communities. The move was occasioned by an increased demand for tallow in soap making by newly established plants on the West Coast and by an emerging necessity to find a sanitary method of quick disposal of the ever-increasing amounts of highly perishable wastes from the growing meat packing and butchering operations.

It was during this period that the demand for beef as a regular fare on the family table began to increase. As the nineteenth century waned and the twentieth began, available means of transportation became faster and more reliable; ice manufacturing commercially for use in cold rooms became more plentiful; rudimentary systems for evaporative cooling came into use and suddenly beef for the table no longer was the by-product of the cattle industry. Soon it became as important as hides and tallow. Quickly it outstripped them both to become the cattle industry's most important product.

Although Nels Peterson probably was quite unaware of it, he was one of a handful of men across the country who were pioneering what today can be recognized as the first full blown recycling industry—an industry which currently is converting some 30 billion pounds of waste fat, bone and muscle tissue from the meat industry into nearly 10 billion pounds of usable products utilized by both industry and agriculture.

Sons Adolph and Nels were given the responsibility for operating the Emeryville facility which soon was serving butchers and meat packing plants throughout the San Francisco Bay-Oakland area, and in 1914 a third son, Otto, made the company's first acquisition—the Los Angeles Fertilizer Co.—which later became the Peterson Manufacturing Co., and today also houses the corporate offices for the Peterson enterprises.

From the Eastern seaboard through the Midwest and on to the Pacific shores the face of a nation changed as the Gay Nineties gave way to the twentieth century. Those changes were paced by the skyrocketing growth of industry. The nation's economy moved farther and farther from its agrarian beginnings as business and industry flourished.

World War I triggered still another new surge toward industrialization as the United States became the major source of the guns, tanks, ships and airplanes that augured for an Allied victory. The influx of immigrants in the latter years of the nineteenth century and the early 1900's already had swelled the size of most major cities and with the end of the first great world war another trend began—young men began opting for city life as opposed to following in the footsteps of their fathers on the farms.

Where the population congregated there the need for food soared upward. Bread, potatoes, milk and, of course, meat. Hogs, sheep and goats—all relatively small animals with proportionately small yields of edible

meat—just were not available (in fact, could not practically be made available in sufficient numbers to meet the demand). It was during this period of great transition that the beef animal really came into his own. Notwithstanding the development of refrigeration, logistical common sense dictated that these huge supplies of beef, as well as pork, lamb and mutton, be slaughtered and packed for market in close proximity to the consuming public.

We already have noted the development of Chicago as the meat capital of the nation. Now, however, not only did other major meat packing centers emerge—Kansas City, Omaha, St. Louis—but almost every city of any size got its own intra-area packing industry. And with the growth of the meat packing industry came the requirement for rendering.

Up until this point the renderer's major contribution appears to have been the production of useful commodity—tallow originally for candles, later for soap and, as oil chemistry technology developed, for glycerine and fatty acids needed by other industries. If you will, however, consider this. Only about 60 percent of the beef animal provides edible products. The hide, bones, entrails, hooves, horns, fat, gristle and tough membranes are, by law, not permitted to be used as food. In other words, 400 or more pounds of a 1,000-pound steer is inedible.

Consider also that animal tissue, once the animal is no longer alive, is perhaps one of the world's most perishable substances. As the kill rate rose in the nation's slaughter houses from tens to hundreds, even thousands of animals per week, without the renderer the problem of disposing of these inedible by-products of the beef industry would have become one of horrendous proportions. Certainly the renderers of that day didn't think of themselves as recyclers, especially since that term has only come into vogue in the 1960's and 70's with the emphasis on our environment. But, in retrospect, it appears they may well have been the original recyclers and as the growth of the rendering industry paced that of our meat industry an automatic and invisible solution solved the problem of that highly perishable waste almost as the problem itself grew.

The contribution of the renderer today to our overall effort to maintain a clean and healthful environment is staggering. Our meat industry—and this must include chicken and turkey as well as the so-called red meats—generates some 30 billion pounds of inedible waste each year. Any city of some size generates a million pounds or more a week. This includes not only the slaughter house and packing plant waste but also that produced by the supermarkets, the local butchers and the restaurants. At some 40 pounds per cubic foot, each city could build one or more monoliths 10 feet square and more than 1,000 feet high with one week's waste. Leave a small piece of uncooked steak out in a warm room for a couple of days and you can get some idea of the immensity of the problem.

So, not only does the rendering industry by its very existence prevent a waste disposal problem of herculean proportions, this 30 billion pounds of inedible waste is turned into some 10 billion pounds of usable commodity—tallow for soap production and the manufacturing of fatty acids which we will see later touch almost every facet of our twentieth century way of life; animal protein which is a major ingredient used in livestock and poultry feed; and feed-grade animal fat which also is used in the food chain, in this case providing a high energy ingredient also used in

livestock feed. U.S. exports of tallow alone account for a favorable balance of trade item in excess of $400,000,000 a year.

As most early renderers point out, the industry was a dirty and foul-smelling business. It wasn't a job for men with weak stomachs. It wasn't pleasant for those whose station in life caused them to live downwind of a rendering plant. In fact, it was this olfactory visibility which caused the renderer to quietly go about his business shunning public attention and actively seeking anonymity.

It was this reason that until only recently—and then due to the development of new technology—renderers considered their industry the invisible industry.

A NATIONAL RESOURCE 2

One who knows nothing or has but a smattering of knowledge about the rendering industry will find it difficult to accept the statement that this hitherto invisible industry is, in fact, a national resource.

But, the fact and figures of rendering and its impact on our late-twentieth-century society more than bear out this claim. For instance:

- The production and sale of rendered products contribute nearly $1.5 billion annually to the gross national product.
- During a critical period when our balance of trade is being thrown out of kilter by the cost of importing petroleum, the export of tallow and grease provides us with a favorable balance of trade item approaching a half billion dollars a year.
- Each year America's renderers supply industry with more than 1.5 billion pounds of tallow and grease—the major material from which all natural, non-polluting soap is based and the raw material from which fatty acids are manufactured. Fatty acids find their way into everything from tires to cosmetics, from paints to synthetic lubricants and from plastics to pharmaceuticals.
- Renderers represent a major force in maintaining a clean environment. Annually, they recycle an estimated 30 billion pounds of highly perishable "waste" material generated by the nation's meat and poultry industries into usable products.
- The rendering industry each year provides those same industries some 1.5 billion pounds of a high energy feed ingredient and almost 6.4 billion pounds of high quality protein ingredient to supplement the food grains that go to produce the beef, veal, pork and poultry meat necessary to give 215 million Americans the highest dietary standards in the world.
- Most significant is the fact that, unlike petroleum, iron ore, uranium or coal, tallow, grease and animal protein are a renewable resource.

In a later chapter the growth and development of rendering from a technological point of view will be discussed. But at this point it is appropriate to examine in some depth economic and social aspects of the industry historically as well as from a current point of view.

Through later 1800's, even as late as 1870, cattle in the West were raised primarily for their hides and tallow, sheep for their pelts and tallow. And in the huge middle America "pork" belt only the hams and shoulders of a large proportion of the hogs raised and slaughtered were marketed as meat. The remainder of the carcass was steam-rendered for lard. Gradually a shift occurred. Meat became the major product of the livestock industry and hides, fats and oils became the by-products. Although tallow and grease now were relegated to a role of secondary economic importance, their uses in industry had begun to increase significantly.

By the turn of the century, processes such as hydrogenation, refining, deodorizing, decolorizing, winterizing and stearin pressing were being

used to alter the basic properties of the raw fats further facilitating their industrial application. Each new process came into being usually as a potential new use came into view or when a traditional use lost ground under the impact of other developing technologies or social preferences. For instance, when candles were important and hard fats were in demand, the preparation of a hard fat from a soft one by separating stearin was discovered. When, with the development of lamps burning oils, oils became more important, the same method of pressing stearin made fluid oils derived from harder oils available. When with the development of the production of vegetable oils these became more abundant than solid fats, lard compounds were developed facilitating the use of oils as cooking fats in countries where hard cooking fats were preferred to oils. This was followed by the introduction of hydrogenation which widened the substitutability of oils for hard fats. And so it went.

As more and more mechanical devices were introduced during the 1800's in industry, agriculture, transportation, etc., the need for lubricants increased. Until the rise of the petroleum industry, the most important lubricants were tallows, greases and vegetable oils. Mineral oils began replacing them in the latter 1800's but this replacement was by no means complete and well on into this century material quantities of animal-derived fats and oils still were used in lubricants. Fats were used as "cylinder oils" to lubricate the pistons in steam engines. They were used for metal cutting and extruding. With the introduction of the automobile and the gasoline engine, animal fats and oils were, for many years, combined with mineral oils. Lubricating greases were compounded of mineral oils with animal grease and tallow, vegetable oils and "soaps" made from these oils. The soaps served not only as a lubricant, but also tended to emulsify the mixture so as to give it the desired consistency.

Early in the development of explosives the value of glycerine, a by-product of soap making in those days, was discovered. It took World War I to really drive home the fact that glycerine no longer could be considered merely a by-product. It was needed and in huge quantities—it took 10 tons of fats to produce the glycerine required for one ton of nitroglycerine. The war also increased the demand for stearic acid, one of the major fatty acids derived from animal fats. Stearic was needed for the manufacture of rubber and was the major lubricant used in drawing metal for shell casings (from those used by the little 45 caliber shell used in the Model 1911 Colt automatic pistol to the three-foot ones fired by the big 75-millimeter guns).

Of course, the major industrial use for tallow and grease continued to be soap but still the needs of the industrial explosion in this country brought on by the war and the United States' role as the arsenal of the Allies probably had the most profound impact of any social or economic development on the rendering industry up to that point.

Originally, the geographic location of rendering plants generally parallel that of the slaughterhouses and meat packing plants. During that period, the industry primarily recycled slaughterhouse offal and packing plant waste and many of the rendering plants were, in fact, owned outright or indirectly by the large packing companies and stockyards. In 1920 an investigation by the Federal Trade Commission (which resulted in a now historic consent decree and the enactment of the Packers and

Stockyards Act of 1921) appeared to break an existing monopoly and trigger a major expansion in the number of renderers then doing business. Reliable records of those days are almost non-existent but from those available it appears that in 1921, for instance, there were some 823 rendering plants in the U.S. Six years later, the *National Provisioner* estimated the number to be 913. That same year, according to the publication, the number of large rendering plants in major cities looked like this:

New York	13	Los Angeles	3
Brooklyn	11	San Francisco	6
Trenton	1	Buffalo	6
Secaucus (NJ)	12	Milwaukee	5
Newark	6	Washington	2
Chicago	9	Cincinnati	14
Philadelphia	15	New Orleans	2
Detroit	2	Minneapolis	9
Cleveland	12	Seattle	4
St. Louis	5	Indianapolis	7
Boston	7	Oakland	3
Baltimore	15	Kansas City (MO)	1
Pittsburgh	10	Fort Worth	1

A breakdown of all these 913 plants shows that the preponderance were located in the north eastern and central states—313 and 466, respectively. Iowa had the most—123, with Indiana second at 111. Pennsylvania had 98, Ohio 81, New York 79, Illinois 61, Massachusetts 51 and California 32. These included, of course, not only the large rendering plants supporting major slaughter/packing plant complexes and large metropolitan areas but also the smallest rural plants.

In 1925, the Bureau of Census made a special study of the industry. The statistics developed, although derived from only 150-odd responses among the 263 companies polled by the bureau, are helpful today in helping gauge the growth of this industry. The bureau estimated that the figures represented about 60 percent of the total for the entire industry or product value of some $30 million. Tallow and grease production (also 60 percent of the total) was 221 million pounds. Production of tankage and cracklings was estimated at 683,000 tons.

A 1927 report from the bureau embracing the statistics provided by 247 plants shows 295 million pounds of tallow, 104 million pounds of grease (including soap stock) and 152 thousand tons of tankage produced collectively valued at $56 million.

By 1950 the U.S. rendering industry was producing more than 2.3 billion pounds of tallow and grease annually. A healthy export market now existed—a market consuming a half billion pounds a year. In 1960, the production figure had increased to more than 3.5 billion pounds and exports were up to nearly 1.8 billion pounds. And in 1970 the same figures stood at 5.4 billion and 2.6 billion, respectively. Although production increased from a little more than a half billion pounds a year to over five billion—a 10-fold jump—the number of rendering plants remained approximately the same. Even today there are approximately 990 plants operating. We must say approximately since even the Department of Agriculture cannot positively say it has all facilities rendering fats on its

list. RENDER, the national magazine of rendering, has identified just under 1,000 companies directly involved in rendering.

Between 1950 and 1972, the rendering industry in this country underwent an extremely traumatic period. The advent of the synthetic detergent in the mid-1950's dealt the renderer a massive blow. Actually, synthetics (primarily based on the use of phosphates) were the result of research by the soap industry aimed at resolving a growing problem with the use of natural soap powders in many parts of the nation. In "hard" waters—water having a high level of mineral deposits in it—soaps then in use developed a curd which tended to remain in the material being washed and to build up from wash to wash. The soap manufacturers found that it was impossible to formulate a washing powder based on petrochemicals and other non-animal or vegetable-derived ingredients that did not form a curd in hard water and that could be manufactured on a cost-competitive basis with natural soaps.

The housewife applauded the appearance of this new washing compound on her grocer's shelves and quickly took to it for her laundry chores. The success of synthetic detergents probably was apparent to the U.S. renderer much sooner than it was communicated to the manufacturer through his yearly balance sheets. For instance, it made immediate inroads on the market for tallow. In 1950, the rendering industry sold 1.1 billions of tallow to the soap manufactureres. The next year that figure was down by 100,000,000 pounds. By 1961 it had dropped to only 732,000,000 pounds and hit an all-time low of 574,000,000 pounds in 1972.

Natural soap products continued, and continue today, to dominate the toilet soap market and a strong market continues for heavy-duty bar soaps and washing compounds used by commercial laundry firms. Thus, the soap manufacturers continue to buy tallow, but little more than half the amount they used in 1950.

Due to the increase in population and significant changes in personal grooming standards across the nation (attributed in large degree to the impact of television advertising), consumption of tallow by the soap industry even registered a modest recovery from its 1972 low and by 1976 stood at some 770 million pounds.

Fortunately for the renderer, a new market for tallow and grease was developing at the same time the demands of the soap producers began to dwindle. Again soaring population coupled with the nation's growing taste for beef was an important factor. And, there was still another factor mitigating toward growth of this new market—the American people began demanding tender, juicy steaks and roasts on their plates, a standard of quality that could not be satisfied by traditional range-feeding methods.

The concept of fattening cattle on corn and other food grains was not new. It had been carried on for years but on a limited basis, fed cattle providing beef primarily for the very rich and for the nation's foremost restaurants. Now, however, a large segment of the general public began to demand beef equal to that heretofore available only from custom butchershops and expensive eateries. Today's huge feedlots are the result.

The cattle feedlot industry, where the animals are taken from the rangelands weighing four-to-five hundred pounds, are placed in confinement and literally force-fed scientifically compounded rations, compresses the natural growth cycle tremendously putting 1,000- to 1,100-pound

steers on the market in short order. Animal nutritionists saw that to enable the animal to assimilate the nutrients provided in this compressed time period still another ingredient—one supplying extra energy—was required. They found this ingredient to be tallow and grease and/or vegetable oil. By 1953 the cattle feeding industry was consuming some 71 million pounds of animal fats each year. This consumption more than doubled by 1954 and had increased by some 600 percent in 1960. Ten years later more than 1.1 billion pounds of tallow and grease were going to the cattle and poultry raisers and by 1976 almost 1.5 billion pounds was being consumed by these industries.

Still another development helped bail the renderer out of the crisis imposed by the advent of the synthetic detergent—the steady increase in the export market. A little over a half billion pounds of tallow and grease was exported by the U.S. renderer in 1950. By 1970 that figure rose to more than 2.6 billion pounds. With the exception of 1975, it has remained well above the two-billion-pound mark every year since.

Thus it can be seen, that growth of the so-called "feed fat" market and the steady increase in world demand for tallow and grease not only replaced the dwindling washing powder market but also kept pace with production which almost doubled between 1950 and 1970.

The economic viability of the rendering industry also has been enhanced in recent years by increased recognition on the part of animal nutritionists of the value of animal protein (meat/bone meal, feather meal, blood meal, etc.) in the formulation of poultry rations. This, as well as the use of tallow in cattlefeed, is discussed in greater detail in a later chapter.

The importance of the Invisible Industry to our economy already is evident and we have a hint of the significant part it plays in the feed chain, but how about its role in the ecology? It may well be that in this area we find the rendering industry's more important contribution to society.

Virtually no one is unacquainted with the nuisance, health and disease problems associated with decayed animal flesh. Unless refrigerated and preserved in some manner, animal flesh rapidly putrifies not only giving off the most sickening and disagreeable of odors, but also providing a perfect environment for the development of disease-propagating bacteria and protozoa. Current sanitation laws and regulations are extremely strict on the manner in which dead animals and animal flesh may be disposed of. Almost universally they require incineration or the equivalent.

Only recently in the new era of environmental awareness has society begun to comprehend the problem of disposing of waste material generated not only by industry but in the process of everyday living. The task of disposing and/or recycling tin cans, glass and plastic bottles, waste paper and packaging materials, etc., are viewed as horrendous.

At least these materials in most cases only take up space and offend the eye. They don't stink and generally do not significantly aid in spreading disease. Consider then, if you will, the task society would face if it had to deal with the physical and the economic problem of disposing of 30 billion pounds of dead animal flesh and bone each year. The immensity of this challenge can be emphasized only in one way—by the use of a few arithmetical gymnastics:

- waste animal flesh and bone compresses to approximately 40 pounds

per cubic foot;

- the amount of this material generated by our meat industry each year and every year would pave a standard 40-foot highway to a depth of one foot extending 3,551 miles—farther than the distance across the United States from San Diego, California, to Bangor, Maine.

And, this isn't all. It must be obvious that all the calves, hogs, sheep, turkeys and chickens born each year do not live to reach maturity. The number that die from accident and disease runs into the millions. The law almost universally requires that these dead animals be disposed of by incineration. It is easy to comprehend what this problem amounts to, say in an area like California's Imperial Valley, where in a 50-by-50-mile area more than a half million head of cattle are housed in huge feedlots at any one time.

Without society's knowledge the problem of handling dead animals in our livestock industry and that of disposing of the inedible flesh, bone and tissue generated by the meat industry has been quietly resolved by the renderer. **Not only has it been resolved without adding to the national tax burden, but that material has been recycled into some 10 billion pounds of usable products each year.**

There still is another way in which the rendering industry offers relief to society, this one also in the environmental area. While the advent of synthetic detergents was a boon to the housewife wrestling with the problems of soap curd in hard water, by the early 1970's the public began to learn that phosphates were imperiling one of its greatest joys and one of the nation's great natural resources—our fresh water lakes and rivers. As the picture began to unfold, we learned that phosphates—which are a fertilizer—promoted the growth of algae and plant life in the waters with an attendant increased demand for oxygen. Both the chemical oxygen demand (COD) and biological oxygen demand (BOD) became so great in many areas there was not sufficient oxygen left in the water to support animal life—the fish and crustaceans. America's Great Lakes, for instance, faced eutrophication.

Pressures from environmentalists mounted. Many prominent scientists added their voices to the demand that the government take action. At first a few individual states enacted laws limiting the phosphate content of washing compounds sold within those states. Pressure on the Federal government to take some definitive action increased and measures were proposed in the Clean Water Act of 1977 designed to limit severely the amount of phosphate marketed in the states bordering the Great Lakes. Other more encompassing and stringent actions were under consideration.

At this particular time seven years of research on the part of the USDA's Agricultural Research Service and the Fats and Proteins Research Foundation, an organization supported by the National Renderers Association, began to show significant promise. The increased pressure to eliminate phosphates, perhaps altogether, and positive results in the research program to find a means of alleviating the problem of soap curd in hard water came at a time when still another outside factor began shaping the future of the soap industry—a skyrocketing balance of payments problem for the U.S. primarily caused by the need for foreign petroleum and the constant threat of embargoes on the part of the Arab oil-producing nations.

Key to any changeover from synthetics to tallow-based detergents has been that tendency of natural soap compounds to form curds in hard water. Much of the water in this country contains large quantities of minerals. The level of these minerals in the water determines the hardness and directly determines the effectiveness of soap compounds. The curd, which the housewife will recognize as the "ring around the bathtub," technically is known as lime soap. The nearly a decade of research primarily was directed toward finding a means to eliminate the curd yet maintaining the basic effectiveness of soap as a cleaning agent.

Discovery that certain surfactants would modify the lime soap led to the formulation of a lime soap dispersing agent (LSDA). Additional research resulted in development of a complete detergent compounded primarily from tallow with LSDA and a small amount of sodium silicate. This detergent features 64 percent natural tallow whereas a typical synthetic detergent may have a 20 percent petrochemical base with 50 percent phosphate "builder."

According to the USDA, the "high detergent natural soap formulation contains 85 percent rapidly biodegradable, environmentally-safe components and 15 percent innocuous ingredients whereas the synthetic formula is 70 percent anti-environmental, with slow and incomplete biodegradation and eutrophication tendencies."

USDA research objectives were to retain the plusses in tallow soap while overcoming the three negative features in hard and cold water. The new soap had to equal synthetics under all washing conditions in modern washers with all kinds of fabrics, while retaining all its inherent safety characteristics.

In comparative tests, cotton and polyester-cotton blend fabrics were washed 25 consecutive times in hard water. Soap alone caused greasy lumps of lime soap to deposit on the fabric. Carbonates caused encrustations on the fabrics. The LSDA soap formula, like a high phosphate detergent, did not cause any buildup of foreign matter on the washed fabric. Scanning electron microscope studies were made to substantiate the findings. "Bundle tests" were conducted by several soap companies and these further confirmed the laboratory results. Toxicity studies for the modified soap formulations were run and showed that the new detergent is non-toxic to humans and animals, is readily and completely biodegradable, is non-toxic to fish and has no effect on algae.

The new soap-based detergent was introduced commercially into Japan under a cooperative program and after two years demonstrated considerable acceptance. Still progress lagged in this country. Understandably, U.S. detergent producers would make no commitment to a new formula when a major ingredient—the LSDA—was not available from commercial sources.

According to the USDA, the first part of that hurdle now has been surmounted. A major, international soap/detergent manufacturer completed a production run of 6,000 pounds of LSDA using commercial equipment and methods in its New Jersey facility. A smaller company with a plant in Florida also is participating in this effort. The LSDA will be used in a pilot-plant project to further demonstrate the commercial feasibility of producing the final, tallow-soap-base detergent.

"We're not out of the woods yet," Dr. Warner Linfield, of the USDA

warns, "and soap-based detergents are going to trickle into the U.S. market, not flood it. Still, for the first time I feel confident we are on our way. One thing the agency must do immediately—let the Congress know how far along we are; emphasize that the technology is available, the product can be produced commercially and its cost can be competitive with petrochemicals, phosphates and other synthetics."

The principle obstacle remaining in general acceptance of the new detergent is the huge capital investment the major producers of soaps and detergents have in their plants and equipment. There simply is not sufficient soap-manufacturing capacity in the U.S., Linfield says.

"When the big switch to detergents came," he points out, "the manufacturers literally put all their eggs in one basket with the synthetics. By and large, a capacity to manufacture natural soap was retained only in the bar soap area while hundreds of millions of dollars were invested in facilities to produce synthetics for the home laundry product market. It is easy to understand why it is going to take strong combined pressure from both political and economic considerations to bring about a switch back."

Nevertheless, it appears that barring some unforeseen surprises, the effort to put natural soaps back on the supermarket shelves and put a big dent in the amount of damaging phosphates discharged into the nation's waters has crested the summit and, albeit a long way, it is downhill from here.

Obviously, the intensive research into development of LSDA has been a self-serving one. It was designed to improve the overall market posture of the rendering industry. The result, however—that of again making natural, non-polluting soap a viable washday product—certainly should have far-reaching effects when it comes to the critical question of maintaining a livable environment, and the rendering industry stands ready to supply the raw material for non-polluting, natural soap.

In still another area, the rendering industry makes a significant contribution to society. It helps Americans to enjoy healthier pets at less cost. To a non-pet owner the value of this contribution is open to question. But to a large segment of our society, it is very important.

Pampering our pets like no other nation, the pet food market tripled between 1965 and 1974, growing steadily throughout 1975, despite the recession. Today, it feeds and cares for 36 million dogs, 36 million cats, 23 million birds and about 125 miscellaneous species.

Even the early 1970's recession did not force Americans to abandon their pets. It did nevertheless compel them to entrench and re-evaluate dietary pet requirements, cutting down luxury canned goods purchases and increasing dry dog food sales, from $65 million in 1965 to $270 million by 1974 are seen reaching market maturity. Increasing sales should reach the $2 billion level by 1986.

In a few words, the pet food industry has become a major customer of the renderer and as such deserves to have its position understood.

That position is reflected by the term "pet food quality" now in common use by that industry to describe exactly what it wants in the form of ingredients.

Pet food quality, the buyer for one of the nation's largest producers of pet food tells us, means meat and bone meal that "is consistent in its pro-

tein analysis, consistent in the amount of ash, consistent in terms of the grind and of good quality—this means the absence of foreign substances."

The requirement for protein content is self explanatory. That's the reason meat and bone meal is used in dry dog food in the first place. Most of the major manufacturers say they use more animal protein in preference to vegetable protein mainly because the consumer appears to prefer it. The consumer, they point out, is the housewife, not the family pet.

"She buys most of the pet food," a spokesman says, "and she reads the ingredients listed on the package almost as thoroughly as she does when she is purchasing food for the family table."

An important point: government regulations require the manufacturer to list the ingredients on the package in descending order according to volume. Thus, if a product contains both animal and vegetable protein the one which appears in the greatest amount must be listed first.

"We find it is an important marketing factor," one manufacturer says, "to insure that animal protein is the major ingredient and tops the list on the package."

In addition to what appears to be a consumer preference for animal protein, meat and bone meal seems to be the major ingredient in the better brands of dry dog food because of some other important reasons. First, animal protein has more fat in it. It improves the flavor and the palatability of the food while at the same time providing needed fat. It also has certain amino acids needed for nutrition that cereal meals do not provide.

Poultry meal seems to be the preference in the manufacture of cat food. It has a higher protein content—60 to 65 percent—which cats apparently need and it also is significantly lower in ash. The cat's system is more sensitive to excess ash than that of the dog. Another prime ingredient for cat food is fish meal. In 1977, (based on estimates derived from use over recent years) it looks like 4.2 million pounds of fish meal will be used to some 17 million pounds of poultry meal. Although poultry meal is preferred, some meat and bone meal also is used in dry cat food.

What about tallow? Well, no firm handle can be gotten on the amount of tallow used, but it is significant. Take one major manufacturer (one of the top in national sales). This company buys tallow at the rate of 125,000 to 150,000 pounds a month. That's more than one-and-a-half million pounds a year. The company's production is in the low end of the top 10. Thus a very conservative estimate puts the tallow used by the pet food industry at at least 25 million pounds a year.

While little meat and bone meal finds its way into canned dog and cat food, considerable tallow does. The variety meats used—livers, lungs, melts and some tripe—are low in fat as are the cereal products. Thus, tallow is added.

From even this too brief and admittedly cursory appraisal, it is apparent that, although it developed and grew over the past 150 years in almost complete anonymity, the rendering industry truly has come to be a national resource.

It has a definable effect upon the economy and a profound effect upon the environment.

Many facets of industry would be hard put to continue operation

without many of the compounds derived from animal tallow and grease.

If livestock producers and poultry ranchers had to rely entirely on vegetable oils and proteins to formulate the scientifically-balanced rations necessary to produce the quality and quantity of meats demanded today, elimination of the competitive element and a market environment in which the demand would outreach the supply would significantly elevate the producers' costs, costs which ultimately must be passed on to the consumer. This would apply not only to the meat and poultry we consume but also to the food we must have to sustain America's love for her pets.

IMPACT OF TECHNOLOGY 3

From the very beginning the growth and importance of the process we today call rendering has been inexorably tied to the development of a major facet of chemical science, specifically fats and oils chemistry, and as we shall later see its future remains closely allied with this area of high technology.

In this decade, close producer-consumer ties also have been established with another area of expanding technology—bio-chemistry.

Essentially, these two scientific disciplines establish secure and ever-growing markets for the products of the rendering industry. Application of other technologies—industrial engineering, metallurgy, production control, quality assurance, automation (and, eventually, computerization), transportation, storage, pollution control, energy conservation, test and analysis—insure that the renderer can continue to meet the increasing demands of these markets.

To better grasp the significance of the role the rendering industry plays in these two key areas of scientific development, it is necessary to turn to Kirk & Othmer's *Chemical Encyclopedia* for a few simple definitions and to Ralston's *Fatty Acids and their Derivatives* for some brief historical positioning.

Fats and oils, as we are concerned with them, are defined as water soluble substances of plant or animal origin consisting primarily of glycerol esters of fatty acids as triglycerides.

Fatty acids are a large group of aliphatic mono-carboxylic acids, many of which occur as glycerides (esters of glycerol) in natural fats and oils. Some of the most common fatty acids are stearic, linoleic, oleic, lauric, palmitic, capric and myristic.

A triglyceride consists of approximately 95 percent fatty acids and five percent glycerol.

An ester, simply stated, is a compound formed by the reaction between alcohol and an organic acid.

Fats are triglycerides that are solid or semi-solid at room temperature.

Oils are liquid under the same conditions.

Waxes, by the way, differ from fats in that they are fatty acid esters of certain higher monohydric alcohols rather than glycerol. Wool grease or fat—also known as degras—is chiefly a wax as is sperm oil.

It is interesting to note that of all fats and oils some 60 percent are of vegetable origin, 36 percent come from animals and four percent from marine life.

Historically, it already is apparent that rendering per se was for hundreds of years merely the process by which soap was manufactured. Fats and oils were boiled together with wood ashes and later with caustic. This chemical process is known technically as saponification and represents the very first known chemical reaction to which fats and oils were

subjected. In fact, it was not until the middle of the seventeenth century that it was suggested—by Tachenium, in 1666, to be exact—that the soap-making process involved the combination of an acid with an alkali as opposed to a simple mixture of fats and ashes. In the mid-eighteenth century, Geoffroy actually isolated the fatty acids but did not fully comprehend what he had accomplished. In 1779, Scheele discovered that when olive oil was exposed to lead oxide a sweet substance which he termed "olsuss" was produced. Four years later, he found he could produce the same substance from a number of other oils. He had, in fact, discovered glycerol. His work, however, ran counter to the main stream of scientific theory at the time and, like the work of Geoffroy, its significance was not apparent until Michel Eugene Chevreul performed his early work between 1813 and 1825. Chevreul became the first to establish the structure of fats and oils and isolated a number of the more important saturated acids. He also succeeded in liberating the field of oil chemistry from the erroneous theories that had dominated it during the seventeenth and eighteenth centuries.

Ralston observes that "Chevreul's work on the fats was initiated by a study of the products of saponification of pork fat which confirmed the presence of glycerol in the saponification products. Treatment of the resulting soaps with hydrochloric acid yielded a solid fatty substance which he named 'margarine' and a liquid which he described as 'fluid grease.' "

Chevreul renamed his margarine "margaric" acid but later, when it was determined to be identical to palmitic acid identified by Heintz in 1857 in his work with palm oil, the term margaric acid was dropped. His fluid grease also was the discovery of stearic acid in 1816 and three years later separated butyric, caproic and capric acids from butter fat. Of great significance was the fact he established that fats are ester-like substances in which the alcohol is glycerol—a statement hotly contested for a number of years but eventually proven to be quite valid.

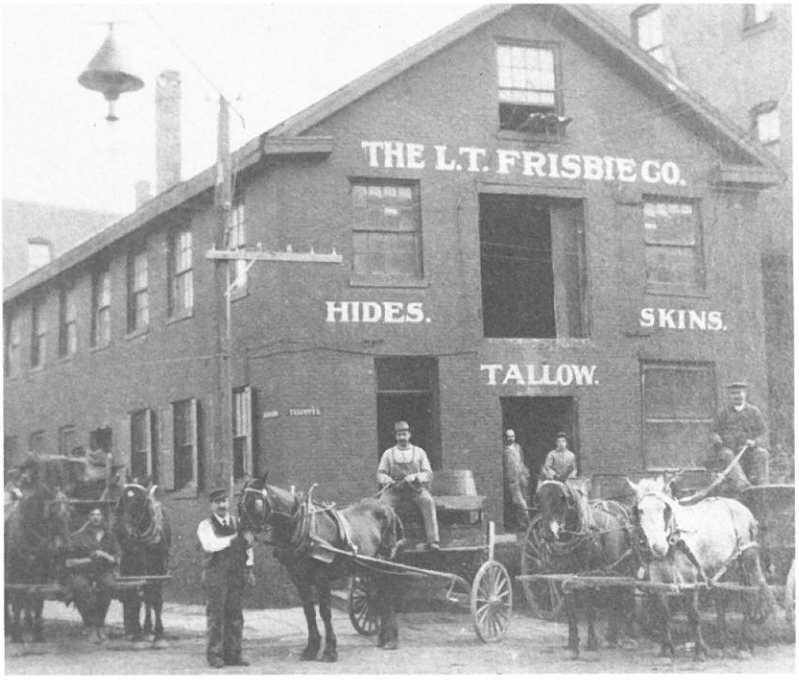
Although many contributed over the next decade to the embroyic science of oil chemistry—Playfair, Gorgey, Marsson, Lerch, Brodie, Gosmann and Kreiling among them—Chevreul, in many ways, might be considered the father of modern oil chemistry and as such one of the most important figures in history with respect to the rendering industry. In fact, the real significance of the development of fatty acid technology became most apparent in the 1950's when the advent of synthetic detergents cut the renderer's market for tallow used in soap production to a fraction of what it traditionally had been. Emerging markets for tallow and oils as a raw material for the chemical industry plus new applications for fats and oils and meat/bone meal for bio-chemical use in the cattle and poultry raising industries not only literally saved the rendering industry but also opened up whole new vistas for these renewable resources.

Perhaps the next major technical development which paved the way for commercial production of fatty acids in large quantities and in an economically viable manner was the development in 1890 of the Twitchell process for hydrolysis. Hydrolysis is the technique of reacting fats with water to form or "split" out the glycerine and the fatty acid. It is only necessary to mix fat with water to attain some hydrolysis. But the reaction is slow. Add sulphuric acid to the fat and the solubility of water in fat is

From the very beginning, transportation was perhaps the most critical consideration to the development of rendering as a viable industry.

Slow though they were, the horse and buggy and the horse-drawn wagon provided the means whereby the renderer could extend his services over a wider area and at the same time increase his sources of raw material.

As rendering plants went, this one (location unknown) was a model in its day.



A "big city" rendering plant at the turn of the century.

Selling his own end products — in this case soap — was an integral part of the business in the early days of the renderer.

A load of tallow on the way to a customer behind a three-horse hitch.

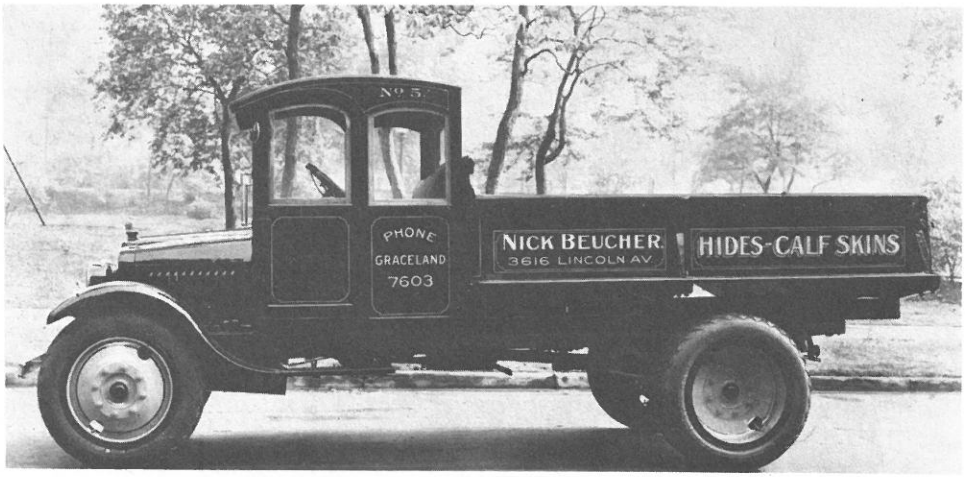
rendering plant
of the century.

The advent of the motor car — in this case motor truck — was a major breakthrough for the renderer. New forms of transportation enabled him to gather his raw material faster from a larger area.

In many areas, even with the availability of the auto, the horse-drawn wagon remained the primary form of industry transportation for a long time.

Urban renderers were the first to convert their entire transportation fleet to the motor vehicle.

Soon the motor trucks were . . . . .



. . . . . getting downright fancy.

vehicle.

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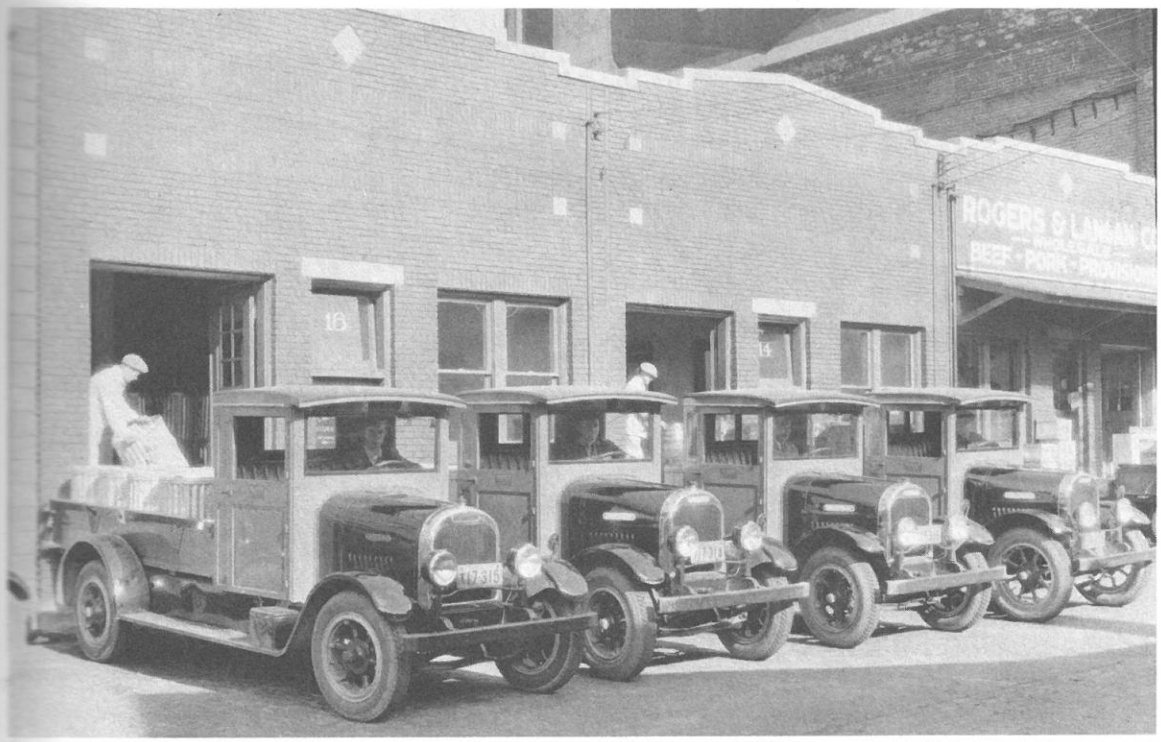
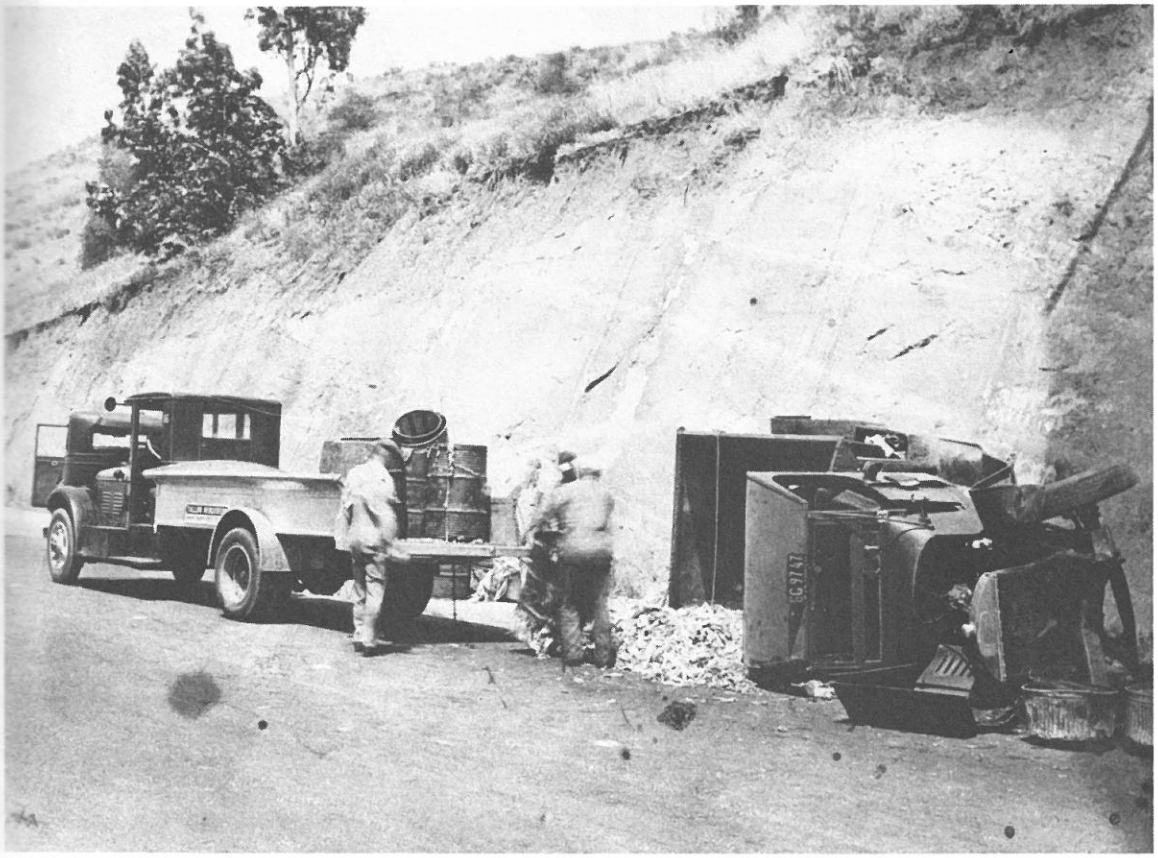


Two-tone paint jobs and everything.



There were times this "new" mode of transportation had its drawbacks.

Today renderers employ more than 25,000 heavy trucks to collect their raw material and deliver their finished product.

Animal proteins move via modern hopper bodies from the plant to the feed mill.

Tank trucks move tallow to the soaper and fat splitter and feed fat to the feed lot and turkey rancher.

hopper bodies

ey rancher.

In recent years, special bodies have been designed for handling the 50-gallon drums in which restaurant grease is collected for re-processing.

Cleanliness is mandatory for the renderer. These route trucks move through an automatic wash rack between every pickup.

Renderer truck fleets today are among the most modern on the nation's highways.

increased, hydrolysis taking place at a faster pace. Twitchell made a major improvement in hydrolysis techniques when he developed the sulfonic acid catalyst which bears his name. This process still is used to a considerable extent in the U.S. although it is being widely replaced by more modern, high-speed systems. Prominent among these is the Emery-Colgate system.

As it is with most modern technologies, it took the demands of a major world conflict to really accelerate development. World War II and the huge demand for glycerine—glycerine produced as a "salt-free sweet water" rather than as spent lye solution from soap manufacturing—saw a major change in what then were industry practices. Whereas, prior to the war, some 70 percent of the total U.S. production of animal fats and oil went toward soap making, the development of fat-splitting operations separate from the manufacturing of soaps provided a whole new source of fatty acids available to the chemical industry. Over the 10-year period beginning in 1941, fatty acid production increased from about 100 million pounds a year to over 300 million. During the next 10 years it increased by another 200 million pounds and by the early 1970's the production of fatty acids from animal fats and oils ranged between 700 million and 800 million pounds a year.

As we will see later when we look at the rendering industry and its products as a true national resource, the end uses of fatty acids today touch virtually every aspect of our way of life.

While it took a world war to push the development of the fatty acid industry and thus to open up new markets for tallow and animal oils, it took the tremendous world growth in population stimulating the need for food to provide the forcing factor in the development of animal nutrition technology presenting still another avenue for utilization of rendered products.

You will recall that in the London Town of several centuries ago soap and candle makers fed the cracklings—solid residue from tallow melting—to the ducks. Over the years it became common practice to use this material to feed livestock and poultry but it has been only recently, as time goes, that we have fully recognized meat/bone meal as one of the major sources of high quality protein for poultry rations. It also has been recognized as an important source of calcium, especially for turkey production.

In 1974, for instance, nearly two million tons of animal proteins were used in producing $15 billion worth of processed feed consumed by some 2.9 billion broilers, 286 million laying hens and 131 million turkeys.

Animal fats and oils, particularly those of low titre (those remaining liquid at room temperature and unsuitable for production of soaps and fatty acids) also have been "discovered" in recent years to be an important ingredient in livestock feed. Again, the ever increasing need for food brought about innovative methods of livestock production, especially beef cattle. The feedlot was introduced. This essentially consists of forced feeding scientifically blended rations to selected cattle held under controlled conditions telescoping the time period needed to bring the cattle to marketable weight. Thus, more quality beef can be made available to the consumer over a given period than is possible when cattle are allowed to attain their full growth on range grass. It requires a great amount of

energy for each animal to convert the concentrated amounts of vegetable protein it is fed into animal protein over the short period. Research by nutritionists show that the animal-derived oil (commonly known as "yellow grease" but technically called "feed-grade animal fat") literally is just what the doctor ordered when it comes to providing the extra energy required. Feed fat also is blended into solid and liquid supplements and used to augment range feeding. Currently, more than one and a quarter billion pounds of feed fat is used each year primarily by the cattle industry but to an increasing degree by poultry raisers, particularly those producing turkeys.

It can be seen how advancing technologies have increased the demand for the products of the rendering industry. And the renderer's sources of raw material—the burgeoning cattle and poultry industries—continue to assure a ready supply of this renewable resource.

In retrospect, however, it probably can be said that the application of rapidly advancing technology—new mechanical devices, new engineering principles, the introduction of automation and, particularly, the implementation of scientific means to insure quality of product—did not keep pace with those technologies that were opening up new markets.

From its very beginnings, the rendering process had been based on techniques almost wholly lacking in sophistication. Still married to the production of soap, the rendering process as described 250 years ago in Ephraim Chambers' *Cyclopedia* of 1728, went like this:

". . .the tallows—referring to the rough fat from the butcher—were cut or hacked into pieces and thrown into a pot or boiler. When perfectly melted and skimmed, a certain quantity of water was thrown in which served to precipitate to the bottom of the vessel the impurities of the tallow that had escaped the skimmer. The melted tallow was then emptied through a sieve into a tub, having a tap for letting it out as occasion required, and was ready for use after standing for three hours. . ."

As late as the post Civil War period, considerable rendering still was being done largely as Chambers described it. Of course, the implements were a little more sophisticated and were largely standardized. The hydraulic press had been invented in 1795, initially to squeeze the oil from flax, and as it gained acceptance in the extraction of oils from vegetable seed it also was introduced into rendering being used to press the tallows and fats from the cracklings. This significantly speeded up the total process and it also allowed the renderer to extract a greater percentage of the fats from his raw material. Along in the late 1800's came the mechanical screw press, invented by V. D. Anderson. Anderson saw a new printing press designed to print on a continuous web or sheet of paper at the Chicago Centennial Exposition. It gave him the idea that a screw operating within a shaft could be used to force vegetable seeds and nuts through a screen thus separating the oils from the meat or cake. The Anderson Expeller® also was adopted by the rendering industry significantly speeding up the production of tallow, oils and meat/bone meal.

The open steam kettles by now largely had given way to the autoclave, a metal vessel which could be charged with its load of fat, bones and offal and then sealed off. Live steam was injected at a specific pressure. Conducting the melting process at higher than normal atmospheric pressure

not only accelerated the process and gave the renderer greater control of the end product, it also enabled him to extract even more of the fat and oil from the raw material. The system of rendering which called for adding water to the raw material (dumping it in the open kettles in the earliest days or injecting it in the form of steam in the late nineteenth and early twentieth centuries) was known as "wet rendering." Since the main objective of the rendering process is, after all, to separate the residual moisture in the raw material from the fat and the solids, the introduction of additional moisture, which in turn would have to be removed, seemed to some counterproductive. Hence, the development of "dry rendering" in which the required heat in the form of steam is applied between the shell of the cooking vessel and an inner jacket. In other words, it does not come in contact with the material being processed. Dry rendering, by the way, was introduced in the 1920's.

At this point it may be well to point out that there basically are two types of rendering requiring two different approaches—edible and inedible rendering. The differentiation comes with the type of raw material. A very small part of the some 30 billion pounds of beef, hog and poultry meat that is not directly eaten as food each year is handled by the slaughter, packing and processing plants so as to retain its eligibility as edible in accordance with the nation's pure food and drug laws. This material finds its market in the form of lard (hog grease) which is used directly, in most cases, as a cooking fat and edible tallow which is used to produce margarines and shortenings. All the lard and edible tallow produced is but a small fraction of the nation's total production, most of it being inedible and used for soap, fatty acid production and feed fat.

Edible tallows require a rendering method employing low temperatures as opposed to the comparatively high temperatures used in inedible rendering. Further, the nature and texture of edible raw material lends itself to separation by high speed centrifuges whereas, by and large, inedible rendering follows the traditional cook and press approach. To accommodate the huge amounts of inedible raw material to be processed and permit accelerated plant thru-put, a continuous dry rendering method was introduced in the 1960's. Modern continuous dry rendering plants have a capacity of processing hundreds of thousands of pounds of raw material weekly. On an annual basis, five to six billion pounds of inedible tallow are produced by U.S. renderers.

Edible or inedible, rendering as late as the 1940's still was relatively unsophisticated. If anything, edible rendering represented a somewhat higher degree of technological advancement due entirely to the fact that the plant environment in which it was conducted was strictly controlled and subject to inspection by the U.S. Department of Agriculture.

What was a typical medium sized inedible rendering plant like in those days? Charles "Chuck" Tocalino, Jr., now president of Modesto (California) Tallow Co., learned the rendering business from the ground up. Chuck's father bought into a small existing plant in 1917 (the wet rendering plant was then five years old) operated by a group of old friends in need of additional capital. As a boy, young Tocalino began working in the plant after school and during summer vacation skinning dead stock.

Too young for military service in World War II, Chuck went off to college—California Polytechnic—but found that the study of nutrition

"wasn't my ball of wax." He joined his father's company on a full time basis in 1946.

"It was just a lot of back-breaking, dirty work in those days," he recalls, "and being the boss's son was no out. In fact, because of it I had to work harder. I had to learn every facet of the job and show the men I could do it as well or better.

"Things were pretty crude. We picked up raw material from the slaughter houses in straight trucks. We didn't even have a dump truck. We shoveled it on and we shoveled it off. At the plant we shoveled it onto the floor, no pit or anything. Then it was hand shoveled into the cookers just like you've seen men shovel coal into a boiler.

"As I remember, we had probably one conveyor that ran to the press. Then we would hand grind it—shovel it into the grinder and shovel the meal to a bagging machine.

"From the cooker we'd discharge the fat into what we called the pan. We'd get the fines and hair out of it and end up with finished material. What we started out with is what we would finish with. If it was clean, extra fancy fat we would get extra fancy finished goods. If it was dead stock and offal, we would get yellow grease.

"We worked a six-day week, 12 hours a day. On an average week our four-cooker plant—by this time we had dry cookers—would handle 150,000 pounds of raw material and with about a 35-percent yield, we would have 50,000 pounds of product to sell. Our total production went to the soapers. The extra fancy they used for their special toilet soaps. The yellow grease went into their old fashioned, yellow, laundry bars. Meat/bone meal went to the local turkey and chicken industry. In those days there was no question of analysis—protein, calcium and ash content, digestibility, amino acid. At that point in the ball game, we had some dry meal and we sold it. We didn't know the value either, and as I look back today, we sold it much too cheaply."

Aside from the amount of pure manual labor involved, what other problems did the renderer face during that time period? Tocalino answers that question in a word:

"Maintenance! It was a headache. There were two main stumbling blocks—the crusher and the press. We were handling everything by hand using shovels—'iron' in other words and everything went on the floor. When you drop everything on the floor, you're bound to get some iron in with the raw material. You get a little into the press and the press goes down. There is only one way to go, rebuild it on the spot. Work straight through until it is done because that raw material keeps piling up. Your agreement with the suppliers is to remove that raw material, get it out of their plant, so it just keeps coming."

So much for the renderer's viewpoint of rendering technology in the first half of the twentieth century. What about the manufacturer of rendering equipment? These excerpts from a 1927 catalogue put out by the Allbright-Nell Co., one of the pioneer manufacturers of rendering cookers and allied equipment, are complete with the marketing superlatives of the day but they accurately depict the state of the art at that period.

"The Laabs Cooker is a scientifically designed apparatus equipped to receive any animal products that may be passed through an 18 inch diameter charging dome. It is a horizontal tank with steam jacket and

central agitator shaft—the ends of tanks are closed securely to permit pressure and vacuum cooking operations, which comprise the wonderful Laabs Processes and make possible a perfect rendering of the original products. Fats, animal tissues and bones are processed so that there is an easy and complete separation, which is accomplished almost without any change to the fats, but with complete digestion and disintegration of animal tissues and bones.

"The Laabs Cookers are provided with doors from which rendered materials are discharged to a receiver prior to their being put through either an expeller or hydraulic type of press. Any free grease will be drained off here, and the press removes the remaining grease down to a comparatively small percent.

"In the old wet rendering process there are four large and distinct operations, while in dry rendering there are three, and in the Laabs rendering there are only two.

"In wet steam rendering tanks materials are digested and disintegrated by steam pressure and agitating produced by live steam being blown through the tank. This digesting and disintegrating process is effected in the Laabs Process in a slightly different way. There is no live steam blown into the materials being rendered, but the materials themselves are heated by steam in a jacketed shell and steam generated from the moisture in the various products. This generated steam is continuously allowed to escape from the cooker, but the amount of steam allowed to escape is retarded—the steam is produced inside the cooker faster than it escapes and a pressure, therefore, results. A revolving shaft with paddles thoroughly agitates the materials being rendered. Disintegration of the largest bones will be accomplished in from one to two hours and, consequently, no grinding of raw materials is necessary."

It should be of considerable interest to Chuck Tocalino that on Page 44 of the ANCO Catalogue a letter dated March 29, 1926, attests to the excellence of the LAABS cookers of that day. The letterhead reads: "Modesto Tallow Company." It is signed by his father, Charles Tocalino.

Another individual who can shed a lot of light on what the rendering industry was like prior to World War II and on into the mid-twentieth century is Don Austin. Austin was not a renderer. Instead, he gained his insight into this industry from a unique vantage point. Austin was employed by Proctor & Gamble, one of the nation's foremost soap manufacturers which, in those pre-synthetic detergent days, depended almost entirely on the renderer for tallow, the basic ingredient for all natural soap. His particular job was to work with the renderers on a nationwide basis to improve the quality of the tallow P&G purchased. For the 40 years prior to his 1975 retirement, Austin worked with the rendering industry developing better processing methods and equipment, developing quality control techniques, working to insure his company of a reliable source of high quality tallow which could meet the increasing demands of the rapidly advancing soap manufacturing technology.

Austin was in the unique position for most of four decades of being able to observe and analyze the rendering industry from without and still work side-by-side with the renderer from within. Thus, he probably knows more about tallow production from the standpoint of improving and maintaining quality than any other single individual. He is known, respected and

held in real affection by renderers all across the nation. Austin is the principal author of the only text on rendering in current literature—*Better Rendering,* first published in 1949—and has personally supervised its regular updating.

Unlike the average renderer who was born to the industry (the majority of the companies are family owned and operated), Austin became associated with rendering because of the depression. He set out to be a doctor but a lack of funds caused him to leave medical school and seek employment. As it happened, that employment was with P&G in process development.

"It was about this time," Austin recalls, "that P&G began to move out of the traditional mold—manufacturing soap in old fashioned batch kettles—and launched an intensive research and development program to find a better, more economic way. In the next few years we brought into being the continuous hydrolizer (fat splitter), a continuous fatty acid still (clarifier) and a continuous flash dryer for fatty acids.

"With this new technical sophistication, the soap industry was ready for a more sophisticated raw material—higher grade tallow from the renderer—but the war intervened. Circumstances dictated that I sit out the war continuing my work in process development in P&G, but, while the conflict raged in Europe and the Far East, those efforts were directed toward explosives, polymers of soybean oil for synthetic rubber and other exotic processes. I worked with all kinds of fats—animal and vegetable—and some of it pretty horrible at that time. But it added several more years of highly specialized process development to my store of experience and at war's end I was convinced that the soap and fatty acid industries needed a grade of raw material that just wasn't available within the technology then being applied by the renderer."

P&G shared Austin's concern and authorized an in-depth study of the rendering industry. The man entrusted with conducting the survey—Don Austin. In a few weeks he left Cincinnati with a complete mobile laboratory bound for Indianapolis and the John Wachtel Co., (now National By-Products) where arrangements had been made for him to work in-plant with the specific objective of finding out how to make light tallow, tallow we today call fancy tallow.

"Although I was an outsider," Austin says, "the people of Wachtel were most cooperative. The fact that the company sold 100 percent of its product to P&G certainly helped. I spent six weeks there and the first thing I learned was that what I might accomplish would only scratch the surface. It would be necessary to study in detail the industry from the raw materials completely through processing to the finished product. However, there also were some specific accomplishments on record when I moved on. In that six weeks, we had proved to Wachtel and to ourselves that the plant could turn out light tallow, in fact tallow with virtually any specifications desired, if the processing were careful and precise. We demonstrated we could take dark, dirty fat and by adjusting the processing could turn out light fat, intermediate fat or a dark grade at will.

"We also learned another interesting thing. We found that intermediate fats when properly processed could be bleached to equal many lighter fats, yet some lighter fats that had been abused could not be bleached at all. It was this initial work that established the 'bleachable fancy' grade we

know today. The new grade cost the renderer more to produce but we could afford to pay a premium for this special handling."

Austin now began to go all over the country studying and working with renderers at all levels—packer renderers that had top grade raw materials, small independents that worked with a conglomeration of raw materials. He recalls that in St. Louis, where there were several major packers with in-house rendering capability, none were making light tallow even though they had access to top grade raw materials. Applying what had been learned in Indianapolis, Austin had the St. Louis renderers turning out high quality, light fat in a few months.

"It was an interesting time," Don recalls, "since even though P&G placed no strings on the cooperating rendering firms, we still were viewed initially with considerable suspicion. We only asked that P&G be given the first crack at buying their tallow at a competitive price. Still many renderers wondered why this big soaper was coming along and offering to improve their product at no expense to them.

"By this time, the early fifties, P&G had formalized this activity—working with the supplier to improve his product, our raw material—and had established a Buying Service as a part of research and development. We now had several men working with the renderers. We also had amassed enough experience to publish a handbook on rendering and make it available to the entire industry. Tremendous strides had been made in just a few years because of two factors: first, P&G had a powerful, self-serving motive—obtain the quality raw materials needed to support its own sophisticated new processing operations; and, second, because of its size, I had available a broad scope of resources to focus on the problem. I also had the confidence and backing of two top managers with great vision—R. A. Duncan and W. S. Martin."

P&G also established a pilot-plant laboratory permitting Austin and the Buying Service staff to conduct research at home rather than on the road. The lab was equipped to work with dry rendering systems then coming into the industry.

Austin recalls that the lab "found little correlation with what was done in the pilot plant and what could be done in the field."

"We found we could not transfer the technology," he says, "and could hardly make bad tallow regardless of the raw materials used. We just couldn't begin to duplicate what we found in the field. It was one thing to develop the processing methods and quite another to get the people in the field to be as meticulous as we were in the lab. It just didn't work, so we disbanded the lab and went back to continuing full-time efforts in the field."

Certainly the variation in raw materials was found to bear on the quality of the finished product, but even more important were such things as the cleanliness of the plant and processing system and the manner in which the raw materials (and material in process) were handled. Also, there was no such thing as a "standard" plant.

"Even today," Austin adds, "there is no such thing as a standard system. Each new plant may use standard components but the plants differ widely. Each new plant is, however, better—more durable, more flexible—than the last."

In the mid-fifties Austin was sent to Baltimore on a special project.

Working with local renderers, he selected various types of tallow being produced running each one through the complete soap manufacturing process for the purpose of correlation. As the result of this effort, P&G, in 1956, asked the rendering industry for a "super" grade of inedible tallow. Thus the specification for "top white" was established; a grade as close to edible as could be made from inedible raw materials; a grade in which the processing could tolerate no abuse; a grade physically "chemically clean," requiring extensive filtering, centrifuging or chemical washing as part of the process.

"Even though we established a requirement and a specification for this new tallow," Austin points out, "we could not have accomplished our goal if we already had not established a remarkable degree of rapport between our company and our suppliers in the rendering industry."

Pacing the requirement for better tallows and comprehensive programs to enhance quality control was the need for more efficient rendering systems, systems which permitted reducing labor costs and still increasing production. The answer was, of course, found in applying automation to develop a continuous system, one in which the raw material was delivered to the plant by modern trucks equipped with special bodies and deposited in a huge hopper where it would be crushed, cooked, the tallow drained off, residual fats pressed from the cake, the cake ground into meal and both tallow and meal transported automatically to storage facilities—all performed without the use of the shovel which Tocalino remembers so vividly.

Today's so-called continuous, dry rendering system was developed by a renderer, Frank Jerome of Baker Commodities, Inc., and Jack Keith of Keith Engineering in 1960. The pilot plant was built at Baker's Los Angeles facility and the first commercial installation went in at the Denver Rendering Co. in 1963. A second manufacturer of rendering equipment, Anderson-IBEC, also converted to the continuous dry system in the early 1960's. Its first commercial installation was made by Tocalino at Modesto Tallow in 1964.

Rendering systems now in use vary widely and range from those which are the epitome of state-of-the-art technology to some still employing the methods of 20 to 40 years ago. Generally, however, they can be divided into six major types, three for edible rendering and three for inedible. Poul Filstrup in his Handbook for the Meat By-Products Industry gives one of the briefest and yet best descriptions of each system. According to Filstrup, the three principal systems in use today for edible rendering are the wet rendering system using autoclaves (batch process); the batch, dry rendering system; and the continuous, low-temperature system.

In the batch, wet system, the oldest of the six systems, the autoclave is filled with pre-cut raw material and closed. Live steam is injected into the raw material at a pressure corresponding to a saturation temperature of about 140 degrees Centigrade. After treatment lasting three to four hours, depending on the size of the vessel and the type of raw material, the pressure slowly is reduced to atmospheric to avoid emulsification. After settling, the free fat is transferred to an intermediate tank where it is allowed to settle further or is separated. The moist cracklings are pressed and dried.

The dry, batch system employs cookers that are steam jacketed and

often a steam-heated agitator is used. Heating is indirect and no moisture is added. When the material is agitated during heat treatment, good heat transfer is obtained and it is therefore possible to employ lower temperatures and still liberate the fat in a batch within a period of one and a half to two hours. Normal moisture content of the raw material is removed by evaporation. After being discharged into a percolator, the free fat is drained to an intermediate tank. It is either allowed to settle or is separated centrifugally. The cracks are pressed or centrifuged and then ground.

In the continuous, low-temperature system, mechanical and thermal treatment are combined to minimize processing time. The raw material passes through a mincer, then continues to an airtight melting section in which it is heated in two stages to about 60 and 90 degrees Centigrade, respectively, in a relatively few minutes. The heated material is separated in a decanter centrifuge designed for continuous removal of solids from a liquid. The cracks leave the system at this point. The liquid, mainly fat but also containing some moisture and fines is further separated. The final purified fat flows through a plate heat exchanger in which it is cooled down to about 40 degrees Centigrade before leaving the plant.

As in the rendering of edible fats, Filstrup says, there are three basic methods in use today for processing inedible material—the conventional, batch, dry plant with mechanical defatting or solvent defatting; the continuous, dry rendering system with screw press defatting; and the semi-continuous, wet/dry system with centrifugal defatting.

A horizontal, steam-jacketed (indirectly heated) cooker is the basic element of the conventional dry method. Again, the cooker usually is equipped with a steam-heated agitator. The cooker discharges into a percolator (a tank with a strainer at the bottom). The material is defatted down to the desired fat content by means of a screw press, a pusher centrifuge or a basket centrifuge. Alternately, the material can be discharged to a solvent extraction plant. Recovered fat is purified separately. During part of the cooking period, the temperature and pressure can be raised to satisfy the provisions of local sterilization regulations. Cooking takes about two and a half hours.

The principle basically is the same for the continuous, dry method as with the dry batch method. The difference—and a big difference is in terms of production—lies in the flow of material into and out of the cooker. It is continuous and as a result the material is treated at atmospheric pressure. Duration of the cooking period depends on the mechanical methods employed to fill the cooker and remove the treated material. Usually, the material is pre-strained and is discharged to a screw press for defatting. Fat is handled much as it is in the batch process.

A so-called, semi-continuous, wet/dry rendering system consists of three main sections—the heating and sterilization section, the separation section and the drying section. In the first section, the material is cooked and sterilized at a pressure above atmospheric (and at a value which corresponds to the provisions of local sterilization regulations). The material remains in the cooker for about 55 minutes. Only part of the water is evaporated during cooking. In the second section, the fat is removed and purified on a continuous basis, leaving the plant as a commercial product before the fat-free matter is dried. Finally, in the third section, the

already defatted dry matter is discharged from the separator to a dryer in which it is held about 20 minutes and is discharged continuously as partially granulated meal with a fat content of from six to eight percent.

The water separated out is discharged to a process water tank, from which a given quantity is charged into the cooker with the next batch of raw material. The addition of process water provides a very high heat transfer coefficient and thus decreases the time required in the cooker. The evaporation rate of water in the cooker is controlled so as to match the raw material supply. No fresh water is added to the process and the only substances leaving the plant are purified fat, dried meal and condensed water from the raw material.

While it is understood that overall methodology may differ plant-to-plant, Filstrup's description of the basic methods provides a good general understanding of current systems and methods.

Seven companies supply more than 90 percent of the new rendering systems being installed in the United States at this time. They include: the Dupps Company, continuous, dry systems; Anderson-IBEC, batch and continuous, dry systems; French Oil Machinery Company, batch and continuous, dry systems; Chemtron Corporation, batch and continuous, dry systems; Pfaudler Company, continuous, low-temperature systems; Pennwalt Corporation, continuous, low-temperature systems; and DeLaval Separator Company, low-temperature, edible systems and continuous, inedible rendering systems.

In addition, four companies share a multi-million dollar market for rebuilt and refurbished rendering equipment. They are: DuMond Company, Industrial Hardfacing,Inc., Alloy Hardfacing & Engineering, Inc., and Pittock & Associates.

"Only in the last several years," according to DuMond's Dick Woods, "has used equipment become a major industry to which rendering and allied industries can turn for their needs.

"Most of the resistance to the purchasing of used equipment was due to the customers distrust of used machinery dealers. This was justified by some of the early dealers who went into business shortly after the second World War. They were people who sold war surplus equipment and distressed merchandise with less than acceptable business standards. Fortunately, for the most part, they have long since departed from our business world."

Woods feels a good analogy for today's used equipment dealer would be a realtor "who represents you in the purchase and sale of homes." Due to professional knowledge of the market and the right contracts, the realtors can buy and sell quicker and easier than the customer.

As it was pointed out earlier in this chapter, all renderers today still are not using the latest technology. It is a matter of cost versus income. A complete, new, continuous, dry rendering system can cost as much as one and a half million dollars and that does not include the pollution control equipment necessary in today's ecologically-aware society. That can cost upwards of another half million or more. Even rebuilt equipment is incredibly expensive. And the rendering system is only a part of the renderer's capital investment. There are fleets of trucks, laboratories, insurance, retirement plans, administration costs and, of course, marketing and sales costs to consider. Plus, as we shall see in a later chapter, the

pollution control requirements—already skyrocketing—are but the tip of the iceberg. As the consumers—soap producers, fatty acid industry, poultry and livestock producers—become more and more sophisticated in their requirements, so will the costs to the renderer for analyses, product guarantees and product liability insurance continue to mount.

Every way you approach it, the impact of technology on the rendering industry is a major concern, perhaps even more so in the future than it has been in the past.

BIG T FOR TALLOW 4

"Tal-low — to color: supposedly so called from the use of this substance for coloring the hair among ancient Germanic tribes, the hard, coarse fat in cows, sheep, etc.; it is melted and used to make candles, soap, etc."

That is tallow according to Webster's College Edition of the *New World Dictionary.*

The Columbia Viking Desk Encyclopedia describes tallow as: "solid fat deposits of animals. Pure form is white, odorless. Used to make soap, candles and butter substitutes."

Entries in other contemporary dictionaries and encyclopedia are not substantially more descriptive or complete. This lack of recognition for a substance which in a variety of forms touches nearly every facet of civilized living today only further emphasizes why the industry which produces it—the rendering industry—has been called "the invisible industry."

In fact, tallow is almost as little known today as it was during the mid-1700's when its use in making soap was a well-kept industrial secret shared by but a handful of craftsmen in all the world.

By whatever definition—archaic or up-to-date, accurate or mistaken—tallow plays an ever important role in industry, finding its way into hundreds of manufactured end products used in every day life as well as being an important ingredient in compounds used to manufacture hundreds of others.

Tallow and its first cousin grease (animal derived) are two of the three major products of rendering. The third is meat/bone meal. All three represent nearly the ultimate in recycling the fats, bone and muscle tissue from the meat and poultry industries which are not consumed as food.

Even statistically, tallow and animal grease are difficult to understand. For instance, statistics developed by the U.S. Census Bureau do not differentiate between tallow and grease. Therefore, for our purposes, we must turn to the U.S. Department of Agriculture definitions which depend on the "titre" of the material. Titre is a term expressed by a number which corresponds to the temperature in degrees Centigrade at which a fat or oil solidifies. Thus "an animal fat is tallow if its titre is 40 degrees Centigrade or higher and grease if its titre is below 40 degrees."

In general, tallow or high titre material usually is derived from rendering beef and mutton fat while greases result from rendering hog or poultry fat. In the U.S., at least three quarters of all the tallow comes from the slaughter of cattle and the preparation of beef for the consumer.

There also are two categories of tallow and grease, edible and inedible. Edible tallow and grease is produced exclusively in rendering plants operated by meat packers under the same inspection and processing standards set by the U.S. Department of Agriculture for table meats. Total U.S. edible tallow and grease production for 1976 amounted to only a half

billion pounds while production of inedible tallow and grease topped the 5.6 billion-pound mark. Some 2.3 billion pounds were exported.

According to current statistics the single largest use of inedible tallow and grease in the nation is as a high energy additive to livestock and poultry feeds. USDA statistics for 1976 indicate that 1.5 billion lounds of tallow and grease went into what commonly is known as "feed fats."

While the agricultural uses of rendered products seem to predominate at least in terms of quantity and from an economic point of view, it is the industrial applications of tallow that have the widest impact on the quality of our late twentieth century way of life.

Perhaps the best known of these is the manufacture of soap. All natural soap is based on the use of tallow and despite the advent of the synthetic detergents over the past 20 years, soap still is a major washing product. In 1976 some $450 million worth of soap was manufactured. This amount reflects bar, flake and powdered soap and is exclusive of scouring cleansers, liquid soaps and exports. Tallow in the amount of 770 million pounds was used to manufacture this soap. During the same period 195 million pounds of coconut oil, 2.1 million pounds of vegetable oils, 2.9 million pounds of tall oil (a by-product of the Kraft process of making wood pulp for paper) and 12 million pounds of other oils were used in its manufacture.

It is of interest to note that despite the fact that soap (made from mutton tallow and causticized wood ashes) dates from biblical times, it did not find common usage as a cleaning agent until the latter part of the 1800's. Until that time it was considered a luxury and was so heavily taxed only the very rich could afford it.

Traditionally, soap has been made by "splitting" the tallow. Technically the process is known as hydrolysis and consists of mixing the crude tallow with water and a catalyst or enzyme under heat—temperatures of 100 to 150 degrees C—to separate the glycerine which then is sold as a by-product. The crude soap is processed further; perfumes, antiseptics, colorings and other ingredients added; and the resulting product made into the popular consumer forms—cake, flake, powder and liquid. The traditional or "batch" process as it is known is a time consuming operation. "Cooking" during which the glycerine is separated from triglycerides (fat) normally takes several days. Although the batch process still is in use even by major soap manufacturers, more and more soapers have switched to a continuous process. In this approach, either crude fatty acids (the fats remaining after the glycerine has been split out) are purchased from a fatty acid manufacturer or the soaper does his own splitting and then consumes the resulting fatty acids in his soap manufacturing activities. A considerable amount of tallow finds its way into the soap manufacturing industry as fatty acid produced by the splitter. This amount does not appear as a separate item in USDA reports, therefore the amount of tallow cited as being used for soap is actually on the low side.

In addition to the more than 770 million pounds of tallow which went directly into soap in 1976, 830 million pounds were used to produce fatty acids. Some of these fatty acids also became soap, but much of the production became either ingredients used in manufactured products ranging from jet engine lubricants to ice cream and cake or as part of compounds used in the manufacturing of hundreds of items from 75

millimeter shell casings to duplicating stencils. In fact, the list is so long it would almost be easier to call out the areas of product and manufacturing where fatty acids do not play a part.

Few products have a wider range of application than fatty acids, yet their versatility in entering combinations in which they lose their identity leaves them unknown to the ultimate user.

Many bland and soothing preparations for personal use obtain their body and "feel" from characteristics inherent in the fatty acid chains present. Use on the body is a natural application, as the fats which normally exist on the skin are of related structure.

Almost any desired level of oiliness, soapiness, waxiness or moistness may be achieved by the balance of the fatty acids used, and the bases with which they are saponified, or combined. The ranges of melting points, softening points and viscosities available from common fatty acids have a natural relation to body temperatures, so that creams and lotions which soften and spread smoothly on application are easily produced. Surface-active and emulsifying properties, as well as cleansing properties, come naturally to the family of fatty acid derivatives. Many of them serve as a bridge between water-solubility and oil-solubility. And where water-repellent qualities are desired in the formula, insoluble metallic soaps based on fatty acids come into the picture.

Stearic acid in the grade suitable for pharmaceutical and edible products, and meeting USP requirements, is notable for its white color, mild odor and high stability.

Multiple distilled oleic acid (white oleine) is also available to meet USP standards, and has a wide range of uses in cosmetics, cleansing creams, and skin protection preparations—generally of the liquid or free-flowing type. Metallic salts of fatty acids, of which zinc stearate is an outstanding example, are used in pharmaceutical products of the dry, water-repellent type.

Foods and food packaging use fatty acids and fatty acid esters as emulsifiers, defoaming agents, stabilizers, surface active ingredients, lubricants and plasticizers. In foods themselves they find application in ice creams, bakery products as so-called shortening extenders, candy and chewing gums, shortenings and margarine.

Among the industrial fields in which fatty acids and their derivatives have application, the textile industry ranks high. To begin with, they serve as wetting agents, generally in the form of neutral soaps chosen to fit each particular fiber and processing step. Uniform dyeing characteristics are imparted by a related group of fatty acid products. Textile lubricating agents produced from sulphonated acids serve another key requirement. In contrast to wetting and cleansing agents, heavy-metal insoluble "soaps" of fatty acids are applied to give water repellency to textiles.

Important advances in the formulation of lubricating grease have taken place—particularly to meet the needs of military equipment—by approaching it as a chemical problem, rather than a compounding art. In these advances, the substitution of fatty acids, or metallic soaps of fatty acids, for natural fats, has done much to assure grease of uniform lubricating and bodying characteristics and which will not separate on long-term exposure to temperature extremes in storage.

Metallic salts of fatty acids, such as linoleates, have a further applica-

tion as paint drier, and metallic stearates as fattening agents. A whole range of other plasticizing, emulsifying and modifying functions for fatty acids are employed in special finishes.

Fatty acids have been found essential over the past 50 years for vulcanizing and compounding natural rubber into a commercially useful commodity. They assist the action of the accelerators, help solubilize the zinc oxide activators, aid in the dispersion of pigments, and lubricate the product during milling and extruding. Polymerization of synthetic rubber takes place in an emulsion generally built around a potassium fatty acid soap.

About three years ago *The New York Times* carried a story originating with the rubber industry to the effect that the combination of a shortage of tallow and high prices (the time was marked by consumer resistance in purchasing beef with attendant slowdown in production) could shut down the U.S. tire industry.

Many people, including a large number of renderers, took this report with a "grain of salt" but a close look at the rubber industry and its dependence upon a constant source of so-called "rubber-grade" fatty acid indicates that any prolonged shortage of tallow would, in fact, have a serious effect on the production of vehicle tires.

To get the full picture of the relationship between the rubber industry in the U.S. (tires for America's automobiles, motorcycles, trucks, farm vehicles and airplanes represent the lion's share of this production) and the rendering industry, it first is necessary to look at the amount of tallow channeled into the fat-splitting segment of the chemical industry and determine what part of that becomes "rubber-grade" fatty acid. Then it also is necessary to learn just how this fatty acid (primarily stearic acid) is used in tire production.

In 1976 the so-called fat-splitters purchased some 830 million pounds of tallow from U.S. renderers. This amounts to 42 percent of the total raw material from all sources, according to the Fatty Acid Producers' Council. The other 58 percent comes from vegetable foots (the by-products of margarine and cooking oil manufacturing), fish and marine mammals, and "coconut-type" fatty acids which include those derived from coconut, palm kernel and babassu, and tall oil.

Two basic categories of fatty acids are produced—saturated and unsaturated—and those have a direct relationship to the raw material source. Saturated fatty acids are those which solidify at ambient temperatures, i.e., they are relatively high titre. Unsaturated fatty acids largely remain in liquid form under ambient temperature conditions. The majority of all saturated fatty acids are derived from animal fats although a small amount comes from vegetable fats. Further, rubber grade stearic acid is a very special product. It is specified as "60-degree Centigrade maximum titre with a minimum iodine value of five." It is almost 100 percent animal-derived.

In this context, 1976 fatty acid production looked like this: 832 million pounds total production; about 504 million pounds of saturated fatty acid with 400 million pounds derived from animal sources. Another 200 million pounds of unsaturated fatty acids derived primarily from animal fats also was produced.

Of the total animal-derived saturated fatty acid products, about 20 per-

cent or 103 million pounds was rubber grade. This was consumed by major U.S. tire manufacturing plants—of which there are quite a number—at the rate of more than one million pounds a year and at rates from a half to three-quarters of a million pounds a year by the smaller plants. Obviously, a considerable amount also was consumed in the manufacture of rubber products other than tires.

The U.S. tire industry produces in excess of 250 million units each year—the latest estimate available is 200 million-plus automobile/motorcycle tires, some 50 million truck/bus tires and more than seven million farm vehicle tires. No figures are available on aircraft tires but there are more than 170,000 airplanes flying today with the average modern aircraft requiring three tires.

As of December 31, 1976, preliminary figures of the American Automobile Association indicate that there were 110 million autos, 5.5 million motorcycles and 28 million trucks and busses on the road—more than 620 million tires rolling along the nation's highways and byways.

So much for statistics.

To learn more about how fatty acids are used in tire manufacturing, we consulted Miles Roberts, chief chemist for the Goodyear Tire & Rubber Company's huge Los Angeles plant. And, by the way, it is tough to get into a major rubber plant. The business is highly competitive. The processes and manufacturing methods are so proprietary in nature that companies normally do not welcome either the public or the press.

Roberts confirms the accuracy of a popular rule-of-thumb that "about two percent of every tire on the road is stearic acid." Actually, the textbook formula for manufacturing tires calls for from one to five parts stearic acid for every 100 parts of rubber. The variation in amount of fatty acid added comes from the difference in the amount of fatty acid in natural rubber versus synthetic rubber as well as from the difference in the amount season-to-season, source-to-source and batch-to-batch.

Normally, more stearic acid is required with natural rubber than with synthetic rubber. Also the amount is more consistent from batch-to-batch. The reason here inherently is more stearic acid in synthetic rubber is due to a soap used in emulsion polymerization. The ratio is about 78 percent synthetic to 22 percent natural rubber compound. On the average, however, the amount of stearic acid runs at two percent of the final product.

The primary function of stearic acid in tire manufacturing is to smooth out the cure rate (vulcanization) so that it is more consistent batch-to-batch. In the curing process, the fatty acid "complexes with zinc oxide to form a rubber-soluble soap" and this reacts with the accelerator (a supplementary compound added to speed up the cure rate) allowing full utilization of the accelerator.

Stearic acid is the main fatty acid used in rubber production. It also has another use—to coat the mold so as to facilitate quick release of the tire from the mold. Zinc stearate is the main form used in this application. Stearic acid is employed primarily because of economics—it is cheaper—and because of the handling characteristics—it comes in easily stored granular or flake form. It isn't, however, the only fatty acid used in tire production. There are times when oleic acid, a liquid (unsaturated) fatty acid is employed.

Under certain conditions stearic acid migrates to the surface of the rubber. This is because it is not completely soluble in the rubber compound. It can happen when there is a longer-than-usual time between processing and curing or when there are variations in the compound.

Then the stearic migrates to the surface, it lubricates that surface. This inhibits the adhesion of one layer to another. If this situation becomes critical oleic acid is used as opposed to stearic. Other fatty acids also are used in rubber products other than tires. Among these is lauric acid.

Important to rubber production is consistency in quality. The industry cannot tolerate variation in quality, the "acid number" is of prime importance and, almost as important, is the need for "minimum non-saponifiables."

From the fat splitter's point of view, this means he looks to his renderer-supplier for tallow with "minimum MIU." This ultimately relates to the acid content and the unsaponifiable level. It means that the splitter needs only high grade tallow for manufacturing rubber-grade stearic.

In the foreseeable future, demand for rubber-grade stearic acid is going to be brisk. Production in 1976 was 103 million pounds or 20 percent of the approximately 504 million pounds of animal-derived, saturated fatty acids produced.

A new and growing use for animal fats and greases—via the fat splitting industry—is in synthetic lubricants. Like many of the so-called new technologies from which today we reap the benefits, the development of synthetic lubricants primarily was forced by war.

In January 1943, the German Sixth Army was stalled in its attack on the Russian stronghold in Stalingrad. Goering had promised Hitler that his Luftwaffe was quite capable of keeping the effort supplied by air. His premise included landing 300 aircraft at Stalingrad every day, an average of one every two and a half minutes.

The airlift had not materialized. Intercepted German radio messages from the Wehrmacht encircled by Russian troops appealed for help.

"The fate of the army depends on tonight's airlift and those of the 17th and the night of 17/18th alone . . . " "On what our troops supposed to live and fight tomorrow . . . " "Fighting more or less pointless, as supply gap can no longer be bridged . . . " "Numerous German soldiers lying starved to death in streets . . . "

Field Marshal Erhard Milch, then Goering's number one man in charge of keeping the Luftwaffe on its feet, dispatched Col. Edgar Peterson to find out what was wrong. Peterson's report was horrifying: there was a 50-mile-an-hour gale blowing, the aircraft were enveloped in huge snow drifts, their engines frozen solid.

At Stalingrad, the German war machine was frozen solid largely because the lubricants needed to keep vehicles and aircraft moving jellied in the extreme temperatures. As the result of the Stalingrad experience, the German High Command ordered experimentation to begin on an accelerated basis to find and develop synthetic lubricants—lubricants that would retain their liquidity as well as their lubricity under these conditions.

These first products were "esters"—an ester results from the chemical reaction of an alcohol and an acid—blended into mineral oils to depress the pour point. However, the first successful commercial ester lubricant

was developed in England in 1947 for use in turbo-prop and turbo-jet aircraft where lubrication problems were high temperature and heavily loaded gears.

A major source of the acids needed for production of esters is fatty acids—fatty acids from tallow as well as from vegetable oils such as palm. Current synlube development—of which most interested companies are reluctant to talk—has been spurred not only by the prospects of accelerated depletion of the world's petroleum supplies and the constantly escalating cost of crude oil but also because, as the result of intensive development for special high and low temperature applications, they now offer a broad range of advantages for everyday use.

As early as 1972, the producers of synthetic lubricants—called synlubes—began large-scale tests to support the contention that their products had advantages for ordinary use in automotive crankcases.

The tests, mainly on police car, taxi, truck and construction equipment fleets, appeared to prove that the period between oil changes (now 5,000 to 7,000 miles in some new car warranties) can be extended to as much as 50,000 miles. In addition, they bolstered the claim that synthetic lubes help cut gasoline consumption and engine wear, because friction is reduced.

What kind of market does this represent? Crankcase products for gasoline and diesel-driven cars, trucks and locomotives total a billion gallons a year or about eight billion pounds. The automobile market alone represents about half the total.

In 1975, Harry F. Reid, Hatco Chemical Division of W. R. Grace & Co., discussed the subject in these terms:

"Until quite recently," he said, "the largest use of ester lubricants has been in the jet aircraft's turbine engine, used both in aircraft and in on-the-ground installations such as electric power generating stations. The use of an ester lubricant permitted higher engine temperatures and gave the engine designer two major advantages. Thermal efficiency of the engine increases with temperature. That means more power per gallon fuel. It also means a reduction in size and weight of the engine for given power output.

"Another advantage is the long life of the fluids. The period between oil drains is as much as 13,000-15,000 hours. It can take five or six years to accumulate those hours on an airplane. The point to remember is that the use of the higher cost ester lubricant is completely justified—not only by performance but also by economics.

"These principles apply on the ground—in automotive and industrial applications—just as much as they do in the air.

"What are the new applications for ester lubricants? There are many of them and many aspects to each. First, let's look at the automotive field.

"Over 40 percent of all U.S. lubricant demand is for automotive use. It is the biggest market—and the only most ready for change. In the use of ester lubricants today, the automotive industry is just about where the aircraft industry was 20 years ago. Synthetic lubricants have not been needed in the past. But there are some needs now. They will grow more pressing each year.

"Crankcase oils—for passenger cars, buses and trucks, both gasoline and diesel powered—are the most important segment of the automotive

market. Perhaps 80 percent of all automotive lubricants—hence, one-third of all lubricants for all U.S uses—go into the vehicle crankcase."

As mentioned earlier an ester is formed by the chemical reaction of an alcohol and an acid. A wide variety of alcohols may be used—monohydric, dihydric (glycols) or polyhydric. Similarly, a number of different acids may be used but these are usually the fatty acids and they may be structured with one or more acid radicals. The term "diester" is applied to the group of esters made from dibasic acids and monohydric alcohols. Similarly, a "polyol ester" is one made from a polyhydric alcohol and monobasic acids.

Reid carefully clarifies just what ester lubricants are and what they are not. They are "synthetic" materials, meaning that they are not petroleum. It is unfortunate that we often use the word "synthetic" to mean "substitute." That leads to the impression of a cheap and shoddy substitute for the real thing. That connotation just does not apply to ester lubricants.

To establish the proper frame of reference, Reid cautions, "consider that:

- "ester lubricants are not, relative to mineral oils, inexpensive.
- "ester lubricants are not replacements for scarce mineral oils.
- "ester lubricants are sophisticated compounds of high purity. Today's products represent the fruit of many years of advancing technology.
- "ester lubricants are problem solvers. They provide excellent lubrication in applications where mineral oils won't work."

What are the true advantages of ester lubricants in actual service? At least four have been demonstrated in field tests.

- Longer life—make no mistake, the engine itself "votes" on the life of the lubricant. It is a mistake to label a product as a "30,000 mile oil." It may be good for 30,000 miles in some engines but it is safer to say that it will last four to five times longer than a mineral oil.
- Engine cleanliness—that has been a popular subject in gasoline advertising. In fleet tests of ester lubricants, the oil filters have not been changed except when the lubricant was changed. Yet, in a typical automobile after more than 20,000 miles on the same filter, inspection of the filter, of the pan and of the oil passageways showed them to be cleaner than those in normal mineral oil service.
- Engine wear—close track was kept of the metal content of the oil by sampling every 2,000 miles and checking levels of iron, chromium, copper and aluminum as well as the levels of the metals that were added in the lubricant additives. However, it was found that the use of certain additives in the fuel would cause remarkable changes in the metals content of the lubricant.

The most "significant data" is obtained when the engine is torn down after 20,000, 30,000 or 60,000 miles. The results often are evident to the naked eye. When they are not, they are confirmed by micrometer measurement of piston ring gaps, and other parameters, by weighing the bearings and by other scientific methods. Test after test has confirmed the advantages of ester lubricants.

These advantages are all measured over a long period of time. For many drivers, it takes a year or more to accumulate 20,000 miles. Most car

owners don't pay much attention to engine cleanliness or engine wear. But a fourth distinct advantage is one that every driver—at least every driver in the northern half of the U.S.—can notice immediately.

• Low temperature starting. There's no wax in the ester lubricant. Its viscosity is plotted in a straight line, even below 0 degrees Fahrenheit. If you recall many years ago putting kerosene into the crankcase to start the engine in sub-zero temperatures, think what a comfort it will be to come back to the airport parking lot some night at 11:30 P.M. and minus 20 degrees and know that your engine is going to start. For that alone, who'll quibble about paying a bit more for an ester lubricant?

These points are clearly defined advantages. However, there may be other advantages about which positive claims cannot yet be made. Possibilities for the future include better fuel economy and lower emission levels. Neither of these possibilities has been firmly established, but tests on both are continuing. As with the aircraft engine, it will also be possible, through allowing higher temperatures, to design future engines for greater thermal efficiency and reduced weight and bulk.

These latter two considerations are particularly important with regard to diesel engines, especially the increased use of diesel engines in the commercial world and especially with regard to the higher horsepower engines now coming into use.

Ester lubricants show great potential not only in the crankcase but in the gear box and as a grease. One gear oil developed to meet a military specification was designed to meet high temperature requirements. But, to the surprise of the developer, it was its low temperature properties that drew the interest of gear manufacturers and fleet operators. One of the striking advantages of ester gear lubricants is the extreme low temperatures at which it retains its fluidity. In tests during the Canadian winter drivers found it easy to shift gears without having first to drive for miles in the creeper gear.

In a military test using a two-and-a-half-ton truck at a desert proving ground, ester gear lubricant was compared with two grades of mineral oil. With the ester lubricant, lower fluid temperatures were noted in both crankcase and gear boxes and "even in the engine cooling system." "Most significant" result was "lower fuel consumption."

Other points to be considered:

An ester grease can withstand the repeated exposure to high temperature on disc brake mechanisms.

Why not trade transmissions cooling systems for ester lubricants? (Lubricants made from mineral oils now operated at the upper limit of their temperature capability.)

Don't forget the turbine. There have been some mechanical setbacks and turbine appears behind schedule. But work still is going on, both for the truck and for the passenger car. The turbine may still be the engine of the future. When it is produced, it will be lubricated with esters.

The total U.S. lubricant market is about three billion gallons a year. It is growing at a rate of about one and a half percent a year. Of the total market, ester lubricants now represent less than one percent. Authorities see the ester lubricant share of the total market increasing to about three percent in just the next three to five years.

Some sources are considerably more optimistic than that. They freely

admit that synlubes are going to be considerably more costly. They also point out that costs of maintenance are constantly increasing—labor as well as components and subassemblies. They feel that when all the costs are considered the higher cost of the synthetic lubricant will be more than compensated for in the other areas.

Just how big an increase in the use of tallow for the manufacture of ester lubricants can be expected is a real question.

Harold E. Mains of Emery Industries, one of the nation's foremost fatty acid producers, points to the increasing importance of "renewable natural fats and oils" to the chemical industry. This term, renewable, takes on major significance in the context of non-renewable resources like petroleum as opposed to a resource that is produced at regular intervals like tallow, palm oil, etc. Since it is virtually impossible to trace tallow through the fat-splitting/distillation/application cycle, we do not know today how much tallow finds its way into synlubes. Thus, we have no certain way of knowing how much will be used in the synlube production expansion now underway.

One fact is plain. As the use of synthetic lubricants increases so will the demand for so-called renewable resources. This obviously includes tallow as well as the competitive vegetable oils.

What remains is for the rendering industry to actively explore more ways and means to direct more of its product into the manufacturing of synthetic lubricants. A good start already has been made in this direction by the Fats and Proteins Research Foundation with funds derived from the National Renderers Association.

Considerable research also is being done by the USDA's Agricultural Research Service. According to the USDA, tallow currently has a distinct edge price-wise as a raw material for fatty acids.

Dr. Gerhard Maeker, chief of the Animal Fat Products Laboratory at the ARS research center in Philadelphia, says that "tallow is the cheapest source of things like fats and fatty acids" needed to make some of the petroleum substitutes currently receiving so much attention.

And the uses of tallow and animal fats in today's society go on and on.

Cutting oils and coolants on which the entire metal-working industry depends are generally emulsions of oil in water, with fatty acid soaps as the emulsifying agent. Stamping and drawing compounds, buffing and polishing compounds and many other applications in metal fabrication, use fatty acids or products in which their lubricating and emulsifying properties are applied.

In the past 20 years, total domestic fatty acid production has risen from less than 200 million pounds to over 800 million pounds. The number and range of products in which fatty acids play a part is ever widening. Today the industry is comprised of some 20 to 25 companies that can meet any fatty acid need. Others continue to concentrate on special types. Where they are divisions of larger businesses, the fatty acid group usually operates as an independent unit with concern for further use of fatty acids equal to that of companies concentrating in the field. Fatty acid producers are organized nationally into their own trade association—the Fatty Acid Producers' Council with headquarters in New York City.

Animal fat in the form of inedible tallow still is the largest single source material for fatty acids. In 1965 some 45 percent of the nation's commer-

cial fatty acids originated from this source and by 1971 that figure rose to nearly 60 percent. This does not include tall oil. While tall oil, once the rosin is removed, provides a major source of fatty acid raw material, the nature of the fatty acids is such that they generally do not compete in the same areas of end use as the fatty acids derived from tallow and other vegetable oils.

One clear advantage animal fats have in the production of fatty acids for industry is in the area of saturated fatty acids. Tallow produces better saturated fatty acids. Vegetable fats are more generally suited to the production of unsaturated fatty acids.

Generally, saturated fatty acids pose little problem with rancidity in terms of handling, storage and shipping. They are, in fact, usually found in their solid state—flake, powder or cake. In varying degrees unsaturated fatty acids are more difficult to handle particularly with reference to rancidity and the vulnerability of the finished product to the colors or odors frequently associated with rancid oils.

Crude tallow fatty acids (the material left after the glycerine is split out) are usually about 50/50 saturated/unsaturated. The unsaturated half is made up of about four percent linoleic and 46 percent oleic acids; the saturated part 23 percent stearic and 27 percent palmitic acids.

In years past, the unsaturated portion was separated from the saturates by a series of pressings under hydraulic pressure. The resulting stearic acids were graded according to the number of pressings and denoted lesser amounts of oleic acid content. The lowest grade was single pressed, the highest triple pressed. Today the saturates are separated from the unsaturated fatty acids by a solvent method with the pressings of yesteryear coinciding with today's stage of refinement. The old terminology, however, still is in general use and a customer is likely to order "triple pressed" stearic acid which in today's specification book carries a special nomenclature designating the ultimate degree of chemical refinement.

Animal fats and grease also are used to produce high grade unsaturated fatty acids such as the oleic family.

Oleic acids also generally are referred to by terminology that has been around for a long time. The term "saponified oleic acids" is applied to commercial oleic acid which has not undergone any appreciable distillation. As it is first separated from the saturated fatty acids in the initial solvent separation (or the old pressing procedure) it is commonly known as red oil and has a distinct reddish cast to it. Thereafter, a number of distillation steps produce single, double and multiple distilled oleic acids—the finest of the latter being almost colorless. Oleic acids today play an important part in the manufacture of textiles and foam rubber and in shampoos and cutting oils.

Together with the rendering industry itself, the USDA Agricultural Research Service continues to be active in developing additional uses for animal fats. The government's interest is, of course, due to the fact that animal fats and greases traditionally are a surplus item in this country and therefore represent an important export. The government also is interested in ways in which a product in surplus at home may be substituted for products which must be imported from abroad.

Important recent USDA work involves the fractionation of beef tallow with an eye to increasing the domestic use of so-called inedible tallows in

edible end-products and at the same time decreasing the cost of those products and reducing U.S. dependence on imported vegetable oils.

The United States is the most important beef tallow producer in the world, supplying about 5.6 billion pounds annually. Approximately half of this beef tallow is exported at relatively low prices when compared to other fats and oils. Only about 10 percent of the total is used in domestic edible products.

On the other hand, cocoa butter, coconut oil, palm oil and palm kernel oil are imported oils whose demand for use in food and confectionery products has been increased over the past few years (the first of these is the most expensive fat in the world).

Beef tallow contains specific triglycerides which also are contained in these imported fats and oils. Through modern technology, beef tallow has been fractionated into products which are compatible with, or superior to the imported fats and oils. It is visualized that products from fractionated beef tallow can be used as substitutes and extenders to cocoa butter, palm oil and other fats and oils in the food and confectionery industries. An economic evaluation analyzed through time-series data and multiple regression techniques establishes the past relationships between per capita consumption of confectionery food fat, beef tallow, cocoa butter, adjusted per capita disposable income, and adjusted costs of confectionery, beef tallow, and cocoa butter from 1956 to 1973.

Prices of the nation's more than five billion pounds of tallow range from one-twelfth to one-sixth the price of cocoa butter. Approximately 5.0 billion pounds have been classified as inedible tallow and 0.5 billion pounds as edible.

To reduce reliance on expensive imported fats, the USDA developed a method to separate the desired compounds from beef tallow. One of the resulting products may be used as a cocoa butter replacement since its properties are almost identical to those of the expensive import. A liquid oil, valuable as a food oil for salad or cooking use, also is obtained as a co-product of the beef tallow separation process. Partial hydrogenation of the oil has resulted in a new family of semisolid fats which require no further franctionation. These semisolid fats have great promise in confectionery and shortening applications. Confectionery, as used in the study, include products such as: solid chocolate, solid chocolate mixed with other foods, panned chocolate and/or confectioners' exteriors, panned chocolate and/or confectioners' interiors, chocolate coatings, fillings and other candy products.

This oil, which currently is being evaluated, is light in color and has extraordinary oxidative stability after it has been deodorized and the legal level of antioxidant has been added. These developments are under commercial evaluation and may make available confections, baked goods and other food products at lower prices to the consumer while diminishing our reliance upon expensive imports. In addition, the research may open up new higher-priced markets for beef tallow now exported at low prices. Also, foreign markets for U.S. tallow are now threatened by palm oil, which has contributed to keeping beef tallow prices down, although most other fats have increased in cost.

Fat is an important source of energy in the diets of U.S. consumers. The annual per capita food fat consumption in this country has increased from

about 115 pounds in 1962 to around 128 pounds in 1972. About 60 percent of this amount is consumed as invisible fats from food commodities such as meats, eggs, dairy products other than butter, cereals, nuts and grains. Visible per capita food fat consumption increased from 46 pounds in 1962 to 53 pounds in 1974. Visible food fats are lard, margarine, shortening, cooking and salad oils and confectionery products. Substitution among visible fats and oils in the food and confectionery industries has continually taken place. Although total visible per capita food fat consumption has increased, vegetable oils have been replacing animal fats. For example, vegetable oil per capita consumption increased from 22.7 to 40.5 pounds during this time period while per capita animal fat consumption decreased from 23.2 to 13.5 pounds.

Edible vegetable oils have become dominant mainly because of sharp growth in soybean oil production at competitive prices, increased hydrogenation processing so that shortenings can be made entirely from vegetable oils, changes in consumer preferences from butter to lower-priced vegetable oils and margarines and consumer trends toward consumption of more unsaturated oils.

This country has also become a major importer of vegetable fats and oils such as palm, palm kernel, cocoa butter and coconut. In recent years these imported oils have found increasing use in the U.S. food industry and confectionery fats, including hard butters, and as a substitute for cocoa butter.

The high price of cocoa butter and fluctuations in world supply over the past few years have caused most manufacturers to consider cocoa butter substitutes, reformulation and price changes in the production of cocoa products and candy bars.

The important lauric fats prepared from palm kernel and coconut oil as cocoa butter extenders have a tendency to develop a soapy flavor upon hydrolysis and are not compatible with cocoa butter. Domestic substitutes have been prepared from fractions of hydrogenated cottonseed and soybean oils; however, they may be only partially compatible with cocoa butter and sometimes develop rancidity. A third type of cocoa butter substitute, made by fractional crystallization of palm oil and blending with a fraction of either Shea or Illipe' butter marketed in Europe, has glycerides similar to cocoa butter but has restricted use as a cocoa butter extender.

The fractionation of beef tallow yields one product with melting characteristics which resemble cocoa butter. In fact, fractionated beef tallow may have an advantage over cocoa butter since changing the parameters of the crystallization or by blending of fractions, confectionery fat of various melting ranges can be produced.

Palm oil is being fractionated in a number of processing plants throughout the world. The two primary products are a stearine used in some of the aforementioned applications and in confectionery and an oil. Beef oil produced in the tallow fractionation has some similarities to this palm oil fraction. The beef oil is an attractive bright oil of light color. The extremely low concentration of highly unsaturated fatty acid moieties ensures its stability when it is properly processed. It can be used in almost any application where fractionated palm oil could be used.

In addition, beef oil may be used as a starting material for many fat

products. It has been hydrogenated under milk conditions to yield a variety of hard butters with designed melting ranges. It may be hydrogenated further to provide shortenings and thus may be used in lieu of a wide variety of products which can be obtained by the hydrogenation of fractionated palm oil.

The USDA has completed preliminary cost comparisons of alternatives for producing fractionated tallow. These cost comparisons were based on a preliminary conceptual process (a process with no actual pilot plant data available). These initial cost comparisons indicate that the products which result from beef tallow fractionation can compete economically with cocoa butter and other vegetable oils in the food and confectionery industries.

The USDA also has been working to formulate new soaps—soaps with the cleaning power of synthetic detergents and without the traditional hard-water problems associated with soap. New formulae using tallow rather than petrochemicals as the basic ingredient have been developed and industry has been persuaded to conduct pilot-plant production but to date costs have been in excess of those experienced in the production of detergents. The world oil supply and price levels could, however, have a profound effect on the soap-versus-detergent question.

The deciding factor may be the inescapable fact that world supplies of crude oil are dwindling at the same time the demand for petrochemical products is ascending at a dramatic pace. Most detergent formulae are based on petrochemicals or their derivatives. Increasing demand paced by decreasing supply equals increased cost, perhaps to a point where tallow, which in recent years has been priced out of reach of the detergent manufacturer (compared with synthetic raw materials), will become competitive.

Still little known and even less understood except by those directly involved with them, animal fats and oils play a huge and multi-faceted role in our twentieth century society—high energy feed ingredient for livestock and poultry; the basis for all natural non-polluting soap; cosmetics; medicines; food products; paints; inks; plastics; rubber products; metal products; fabrics; sophisticated new lubricants and many older not-so-sophisticated ones.

Perhaps we aren't really stretching it too far to spell tallow with a big T.

CLOSING THE LOOP 5

The population of these United States moved through the 215-million-mark in the mid-1970's despite a significant reduction in the birth rate. In other parts of the world, however, no decline in births tended to slow the population explosion which has been the hallmark of the twentieth century. On the other hand, new found medical knowledge began infiltrating even the more remote areas of the earth bringing with it significant increases in longevity. To many world leaders and scientists, these developments portend disaster in the making—that time when world agriculture can no longer provide sufficient food. In practical terms, however, that time, when and if it comes, certainly will not be faced by our generation. Nor will it be seen by our children, our children's children or even their immediate offspring.

Just as medical science has extended the life expectancy of mankind, so has agricultural science not only increased our supplies of food but it also has expanded the sources of foodstuffs and improved enormously its nutritional value. In this area, the invisible industry has played an important role.

Little is known about the origin of the phrase "bread is the staff of life." In the sense that bread equates to the world's food grains, that phrase probably is as true today as it was when it was coined. Over the past half century, however, we have become increasingly aware of the importance of protein—the need for quantities of high quality protein quite beyond that supplied along with the carbohydrates and minerals in the grains we consume. To meet this need, we have expanded dramatically and continue to expand our sources of red meat, poultry and sea food. It is in this area that the rendering industry makes an important contribution, closing the protein loop as it were.

It is obvious that many major changes in the manner of raising poultry, processing it and getting it to market were necessary in achieving the high level of efficiency that marks today's poultry industry. Perhaps the most important of these was in the area of scientifically prepared and balanced rations and advanced feeding methodology. And it is in this area that rendered products play a major role.

That role is put into better focus by Dr. Henry L. Fuller, one of the nation's foremost authorities on animal nutrition.

According to Dr. Fuller, "animal proteins, historically, have been considered indispensable in rations for all classes of animals except herbivora. Many of the earliest recorded nutrition experiments compared animal proteins with vegetable proteins and invariably the former were found to be superior in promoting the growth of young animals, including chicks. For many years this nutritional superiority was considered to be inherent in the protein itself.

"As we began to characterize proteins on the basis of their amino acid

content, some of the mystery of animal proteins was eliminated. We learned that we could match their amino acid composition with combinations of vegetable proteins or by supplementing the vegetable proteins with amino acids. Even with this enlightened approach, animal proteins continued to provide some nutritional values not found in vegetable protein supplements.

"With the discovery of vitamin B-12 and its identification with the animal protein factor, it was thought by many that we would no longer be dependent upon animal proteins. Still, feeding tests continued to show a need for something that these animal protein supplements contributed to the diet, especially in practical poultry rations. We called it 'UGF,' or unidentified growth factor(s)."

For nearly 20 years, ever since the discovery of vitamin B-12, scientists continued to look for this unidentified growth factor (or factors). Considering the accelerated rate of scientific achievement with our sophisticated techniques and tools, Dr. Fuller said, it would seem reasonable to conclude either that no such entity exists or that it must soon be discovered and identified. If the former is true, he reasoned, that UGF is non-existent, then the improved performance obtained by animal and marine by-products must be the result of improved nutritional balance provided by the concentrations or availability of some known nutrient or nutrients in these ingredients.

In 1967, Dr. Fuller reported: "Some of the experimental data we have collected at the University of Georgia in practical feeding trials seems to support this premise. These experiments were conducted under simulated field conditions at our broiler research center. Each trial consisted of five treatments and each treatment consisted of either two or four replicate pens of 400 chicks, evenly divided between sexes."

The tests involved adding fish meal, poultry by-product meal and meat/bone meal to the rations. Essentially, these early tests demonstrated that improvement in growth and feeding efficiency associated with adding animal proteins to the ration actually involved both the availability and digestibility of certain amino acids involved singly and in combination in the basic ration as well as in the added ingredients.

Those tests were exciting to Fuller and other animal nutritionists and subsequent research was scheduled throughout the 1960's and into this decade with the result that a considerable body of scientific knowledge now is on hand with respect to the critical part played by amino acids in nutrition and the best sources of those amino acids. This information is especially valuable today when rations are formulated largely by computer. Armed with an analysis of the feed ingredient in terms of protein content (including individual amino acids), calcium, phosphorus, etc., and the current cost of the ingredient, the nutritionist aided by the computer can formulate an efficient, minimum-cost feed ration. When one considers that in the United States alone some 35 million tons (some 70 billion pounds) of feed are used each year by our livestock industries, the significance of this kind of information becomes evident.

From the standpoint of the rendering industry it is important to recognize that animal proteins, one of the three major finished products of the renderer and traditionally a key source of protein for livestock feed, continues to meet even these stringent new nutritional criteria and more

often than not represents a significant economic advantage. In fact, rendered products—meat/bone meal, poultry by-product meal, feather meal, blood meal, etc.—are so much in demand as high protein additives to livestock rations the average yearly usage for this purpose is in excess of four billion pounds. Feed fat, the same product used extensively as a high energy additive to cattle feed, also is used but to a lesser extent in poultry feed to supply energy.

One of the best and most comprehensive descriptions of animal proteins and what they contribute to livestock production comes from Dr. D. H. Sherwood, a veteran expert in poultry research and feed formulation. Dr. Sherwood puts it this way:

"Hydrolyzed poultry feathers is the product resulting from the treatment under pressure of clean, undecomposed feathers from slaughtered poultry free of additives and/or accelerators. Not less than 80 percent of its crude protein content must consist of digestible protein.

"Feather meal is higher in cystine than other common ingredients, so it spares the use of methionine which is expensive. This is because chickens possess the ability to use methionine to satisfy their need for cystine, but can't use cystine to satisfy the methionine requirement. With most diets the requirement for methionine is met before the requirement for methionine plus cystine, but if larger quantities of feather meal are used there may be a deficiency of methionine. Feather meal is also low in lysine. Therefore, in formulating diets high in feather meal, special attention must be paid to methionine and lysine.

"Some feather meal is now produced by a relatively new continuous process known as the Albright method. Some feather meal produced by this method runs as high as 92 percent protein, and the lysine content tends to be higher than in conventional feather meal. It is claimed that the lysine of feather meal produced by the Albright method is more available to the chick than the lysine of feather meal produced by the older methods.

"Meat meal is the finely ground dried residue from mammal tissues exclusive of hair, horn, manure, stomach contents and hide trimmings, except in such traces as might occur unavoidably in good factory practice, especially prepared for feeding purposes by dry rendering. If the product contains more than 4.4 percent phosphorus, it must be designated 'meat and bone meal.' If the product bears a name descriptive of its kind, composition or origin, it must correspond thereto.

"The phosphorus of meat and bone meal, as well as other renderers' products is, of course, completely available to all classes of poultry, or other single stomached animals. By contrast the phosphorus of vegetable materials may be less than 35 percent available to the chick. For example, soybean oil meal contains 0.65 percent total phosphorus, but because much of this is present as phytin phosphorus, the available phosphorus is only 0.19 percent. In computer formulating diets for young chickens, it is more important to compute on the basis of available phosphorus than total phosphorus.

"Meat and bone meal is more commonly used in layer feeds than in broiler feeds, though it may be used in broiler feeds at relatively low levels. The high calcium content limits the use of this product in broiler feeds, and also the amino acid content is somewhat more variable than in

some other ingredients. Meat and bone meal is well adapted to use in layer feeds, where the high content of calcium and phosphorus is an advantage. We have learned that where most of the calcium in laying feeds is supplied by limestone that calcium tends to separate out in the automatic feeder line—this is more pronounced in some types of automatic feeder than in others. Meat and bone meal helps to prevent this separation. The bone of meat and bone meal can supply a significant portion of the total calcium requirement. The bone in meat and bone meal is nearer the same density of other feed ingredients than limestone, and therefore would be less apt to separate. Further, the presence of fat in the feed helps to prevent separation, and meat and bone meal is high in fat.

"The calcium and phosphorus content of meat and bone meal may vary considerably from one producer to another, therefore when relying on this ingredient to supply a significant amount of the phosphorus to a diet it is well to make certain of the phosphorus content of the material actually being used.

"Poultry by-product meal consists of the ground dry rendered or wet rendered clean parts of the carcass of slaughtered poultry, such as heads, feet, undeveloped eggs and intestines, again exclusive of feathers except in such trace amounts as might occur unavoidably in good factory practice. It must not contain more than 16 percent ash and not more than 4 percent acid insoluble ash. The maximum insoluble ash standard is included so that care will be taken to eliminate as much insoluble grit from the intestinal material as can be done in good factory practice.

"Poultry by-product meal is an excellent ingredient for either broiler or layer feeds. It is higher in protein, energy, calcium and phosphorus than soybean oil meal for example. It is lower in lysine than soybean meal, but if normal amounts of soybeam meal are used this is not normally a problem. Of course the computer would normally be programmed with the lysine requiremrnt of the particular feed that was being formulated. The methionine plus cystine content of poultry by-product meal is higher than that of soybean oil meal, and amino acid availability of the material, when properly processed, is usually around 98 percent. In some of the newer installations the Albright method of processing referred to for feather meal, is used. We have used levels of poultry by-product meal as high as 15 percent in broiler feeds with excellent results.

"Sometimes poultry by-product meal and feather meal are processed together. This is not commonly done, and is not considered to be as desirable as processing the two separately. Some authorities feel that when the two were processed together if the feathers were cooked properly, the poultry by-product cooked with them would be overcooked. If the poultry by-product was cooked properly, the feathers cooked with it would not be cooked enough. Overcooking results in some of the amino acids being made biologically unavailable, and if the two materials are cooked together the amino acid availability is seldom over 90 percent, but as mentioned is frequently as high as 98 percent when each is properly cooked by itself.

"Poultry by-product meal and feather meal normally are both produced in the poultry growing areas, and thus are available for use in poultry feeds at relatively little freight cost.

"Blood meal is ground dried blood made from blood collected at pack-

ing plants. Blood meal contains 80 percent or more of protein and is very low in calcium and phosphorus as well as total ash. Blood meal is less apt to find a place in commercial poultry feeds than other renderers' products. Many feed formulators have considered the protein quality of blood meal to be poor, but this has been largely due to the overheating of the product in some of the older processing methods.

"The high lysine content of blood meal that has been properly produced by the 'ring' or 'flash dried' method, would be of value under some circumstances. Lysine is one of the essential amino acids, and in a common commercial broiler feed is apt to be the second most limiting amino acid after methionine plus cystine. If most of the protein of a feed comes from soybean meal, there is not apt to be a lysine deficiency, but if much of the protein comes from such ingredients as corn gluten meal or feather meal, there might be a lysine deficiency.

"Animal fat is obtained from the tissues of mammals and/or poultry in the commercial processes of rendering or extracting. It consists primarily of glyceride esters of fatty acids and contains no additions of free fatty acids or other materials obtained from fats. It must contain not less than 90 percent total fatty acid, not more than 2.5 percent unsaponifiable material and not more than 1 percent insoluble matter.

"Fats and oils are the most concentrated sources of energy for use in poultry feeding, but for the most part the only nutrient they supply is energy. In some cases there might be a plus value from the linoleic acid contained in varying amounts by the different fats. Because of the high cost of vegetable oils, the choice of a fat normally is between the several animal fats, such as tallow, lard, and grease, or a mixture of hydrolyzed vegetable oils and animal fats.

"In addition to the energy supplied to a feed by fat, there are other advantages to using fat in a feed. Using a fat in a poultry feed reduces dustiness, and makes the feed more palatable, and it is commonly felt that it helps prevent the separation of ingredients, thus bringing about a more uniform mixture. Of course these latter advantages would occur in a mash feed, more than in a pelleted feed. Fat is normally used in broiler feeds, which for the most part are pelleted, as a source of energy. If a feed containing more than two or three percent fat is pelleted, the resulting pellet is quite soft and suffers excessive breakage in commercial handling. Spraying fat on the outside of the pellet actually hardens a pellet, and as much as five percent fat can be sprayed on the outside of a pellet.

"Where a high level of fat is added to a broiler feed there is an advantage to using an animal fat over a vegetable fat. The less saturated vegetable fats result in the fat of the carcass of the bird being softer and may lead to a 'greasy bird' problem. Some nutritionists also feel that there is more of a problem with excess moisture in the dressed bird when a vegetable fat is used."

In summary Dr. Sherwood says:

"1. Animal fats are well adapted for use in poultry feeds, not only because of their availability, and high energy level, but from the standpoint of decreasing dustiness, improving palatability, and decreasing separation of other ingredients.

"2. Blood meal is less commonly available than the other renderers' products, but is high in protein, and in the amino acid lysine. When blood

meal is processed by the ring or flash dried method, the lysine is much more available than when processed by the older vat method.

"3. Hydrolyzed poultry feathers are unusually high in protein and the amino acid cystine. Because of the unusually high cystine level less of the expensive methionine is required, but minimum levels of methionine and lysine must be observed.

"4. Meat and bone meal is an excellent ingredient in layer feeds. The high level of calcium and phosphorus is an advantage, plus the fact that it helps make the feed more palatable and prevents separation of ingredients.

"5. Poultry by-product meal is especially good in broiler feeds because of the high level of protein, essential amino acids, minerals and energy.

"6. In general, renderers' products have values beyond those which can be programmed into a computer. These include a decrease in dustiness, improvement of palatability, and helping to prevent ingredient separation."

While the emphasis during the 1960's and early 1970's had been on firmly establishing the value of rendered products primarily for the cattle industry (energy) and poultry industry (protein), in more recent years they are being considered as a replacement for milk and milk by-products in raising calves, particularly those intended for veal production. Experimental programs also are underway to determine the value of adding meat meal to swine rations.

Because of a series of experiments conducted by the Animal Science Department of Brigham Young University, the proudly stated claim "we use only milk-fed veal," which has graced the menus of fine restaurants for many a decade, may become a thing of the past.

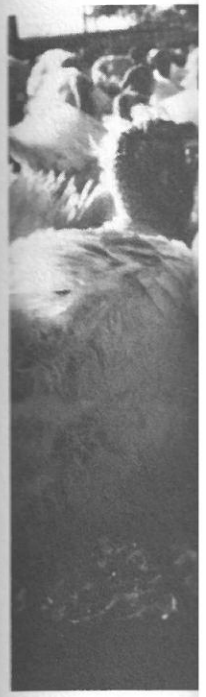
Spurred by strong economic factors—a growing scarcity and escalating cost of milk—Dr. Robert W. Gardner and the BYU researchers embarked on an intensive study designed to substantiate a belief that industry objections to grain-feeding veal calves could be alleviated through utilization of feed fat and meat/bone meal in the calf starter rations.

"The evidence in favor of grain-fed veal is formidable," Gardner announced at the conclusion of the experiments, "raising acceptable veal on grain rations supplemented with animal fat seems promising. The economics of replacing milk or milk by-products with grain is particularly appealing."

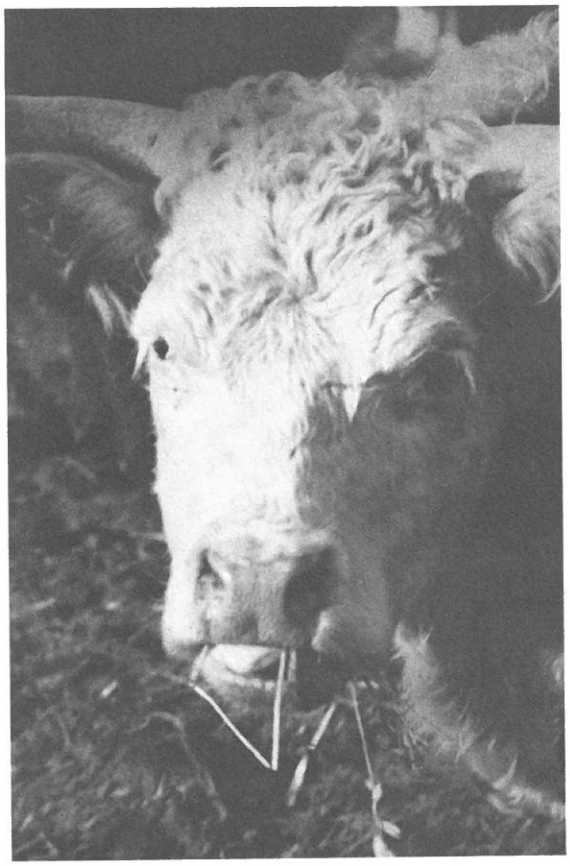
Gardner says that in the past three main factors have discouraged feeders from attempting to grain-feed veal animals when the carcasses have been compared to milk-fed calves. These are:

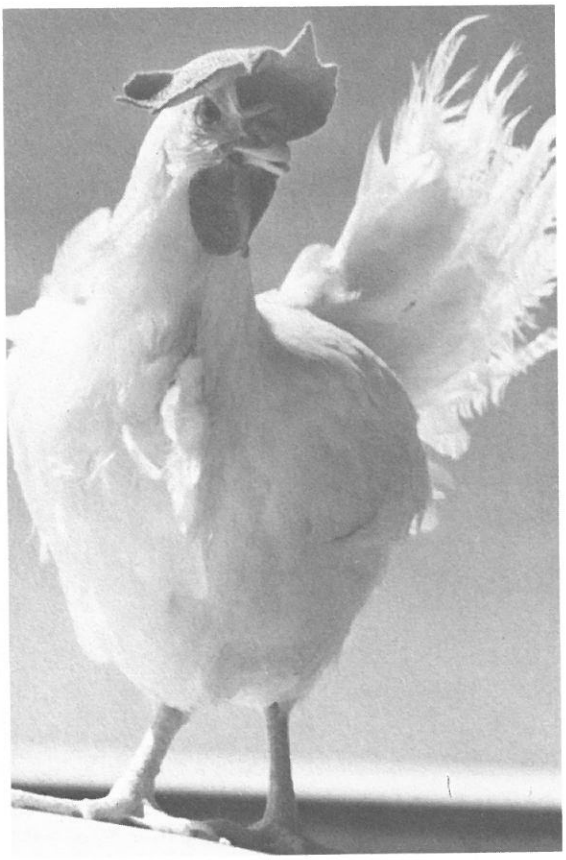
- inadequate fat covering of the carcass,
- off-colored or "watery" fat, and
- darker red meat due to more iron in the feed as compared with milk-fed animals.

To begin with, Gardner declares, most comparisons of grain-fed with milk-fed calves have been made at equal ages rather than at equal weight. This favors the milk-fed calves since they are heavier at a very young age. There is good evidence, he claims, that animals deposit progressively more fat with each unit increase in body weight. Thus, slaughtering at comparable carcass weights would tend to equalize fat deposits. A second possible reason for more fat covering as well as color and quality of fat in



The beginning an poultry industry s product each yea billion pounds of grease returns to tions.

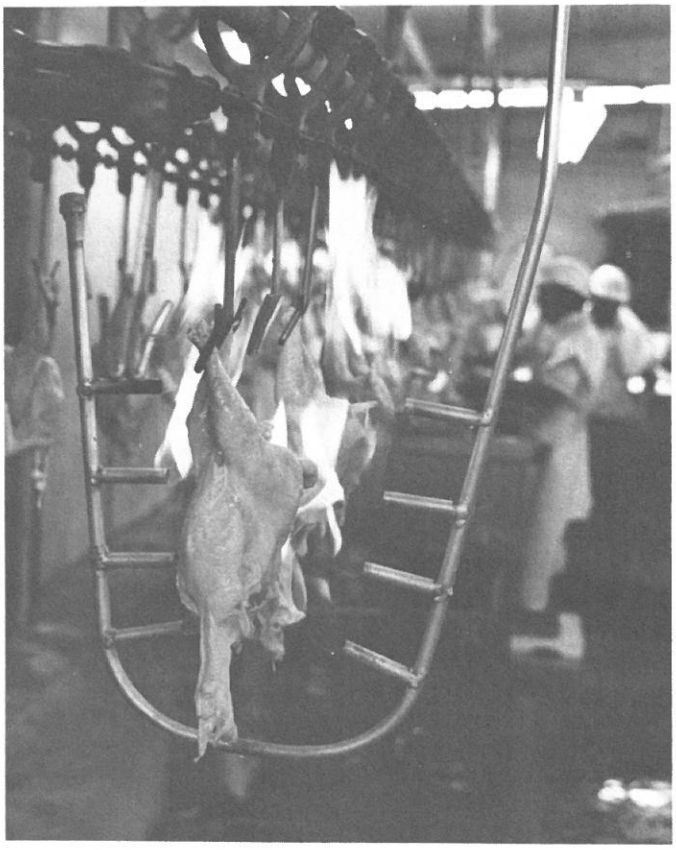




The beginning and the end for the renderer — the beef steer, the broiler, the turkey. America's meat and poultry industry supplies the rendering industry with more than 30 billion pounds of highly perishable waste product each year — waste which is recycled into some eight billion pounds of tallow, grease and nearly three billion pounds of animal protein meals. Nearly all of the animal protein meal and much of the tallow and grease returns to the cattle and poultry industries as high energy and high protein additives in livestock rations.

Obviously, the meat packer is a major supplier of raw material for the renderer. More than 60 percent of the beef animal does not end up on the dinner table.

The local butcher and supermarket are other sources of raw material for the renderer.



Broiler processing plants generate some 800 million pounds of fat and solids annually for the renderer.

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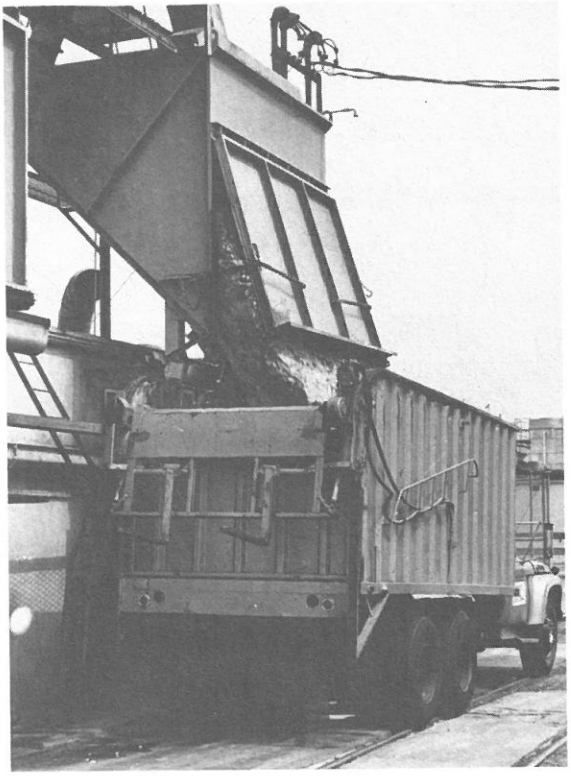
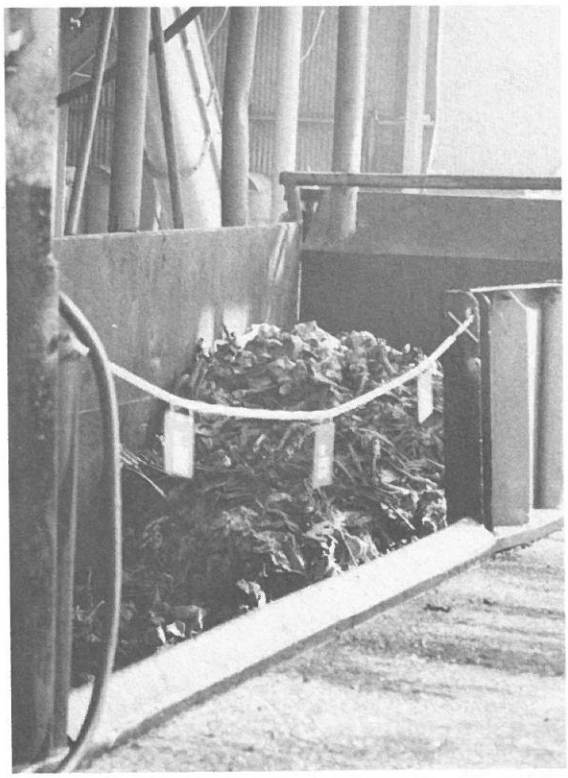
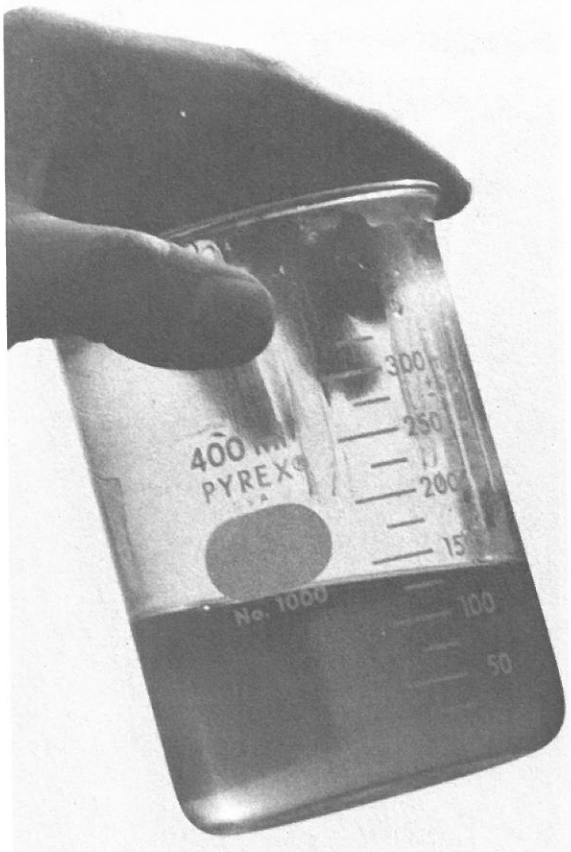
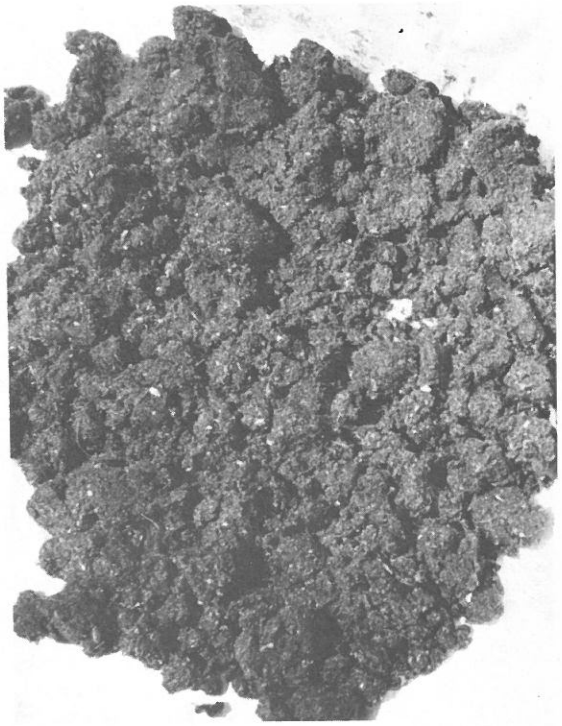


This load of feathers and entrails will be turned into feed fat and high protein feather meal by the renderer.

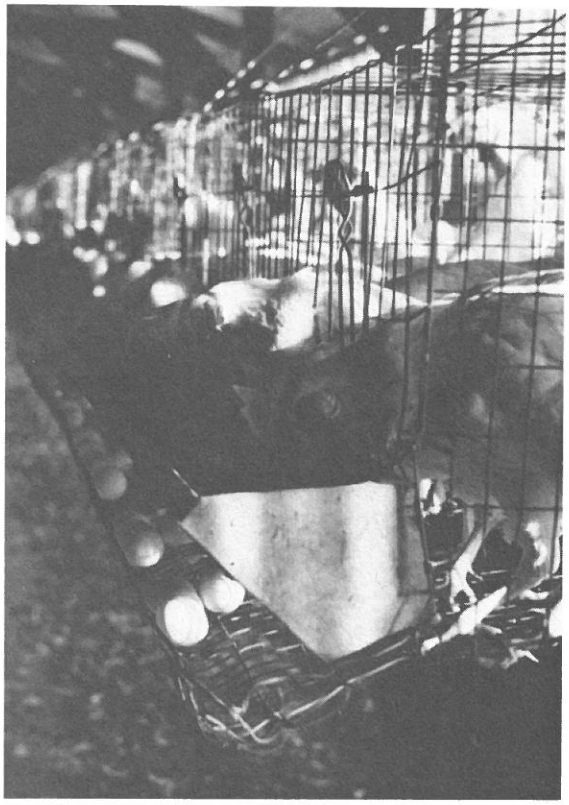


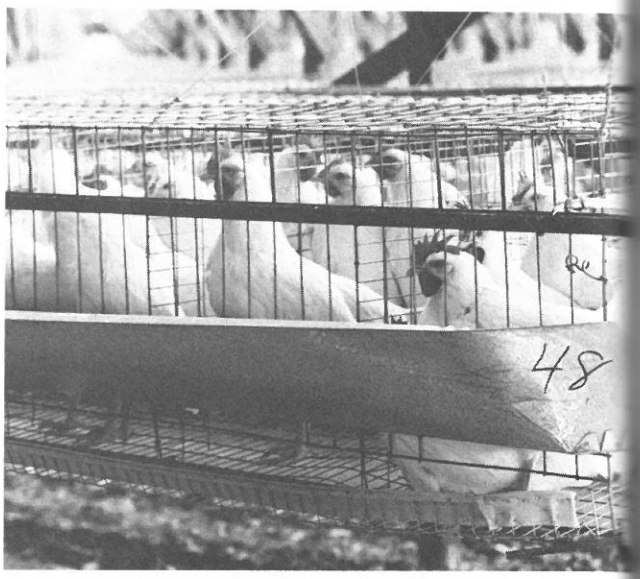
These bones, together with the fat from a packing house, will become tallow and high protein meat/bone meal.





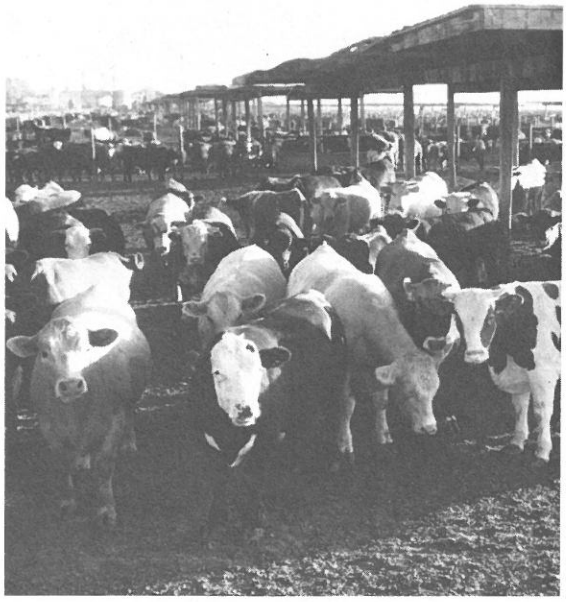
The renderers' main finished products — tallow heated to its liquid state is a clear, golden fluid; meat/bone meal, long noted for its high protein content as a livestock feed additive, now is in demand as a major pet food ingredient.



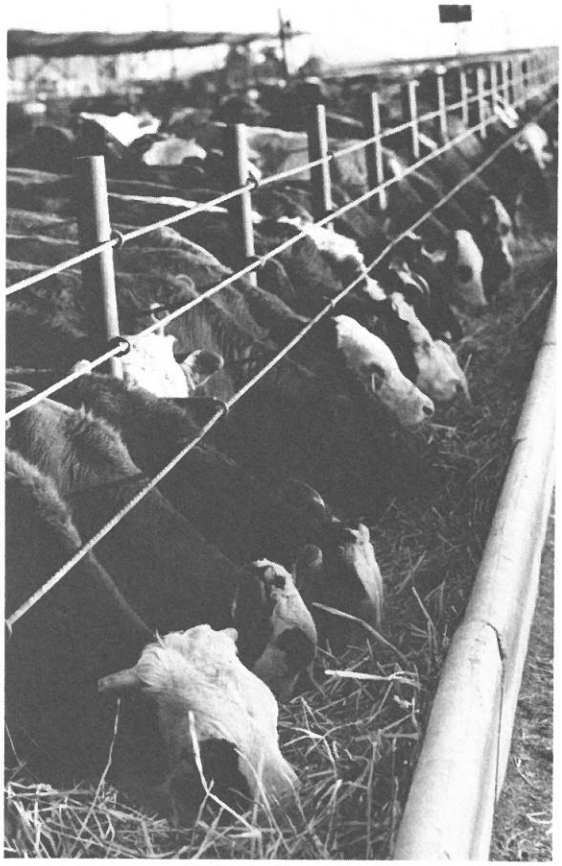


Animal nutritionists today consider the renderer's animal protein meals an important and cost effective ingredient in rations for both layers and broilers.

Fat is mixed u
ways. Here it
sprayed on ha



In 1977 the National Renderers Association estimates some 3.4 billion pounds of feed fat was produced in the U. S. with most of it going to provide a high energy ingredient for the cattle feeding industry.



The fat storag
the feedlot an

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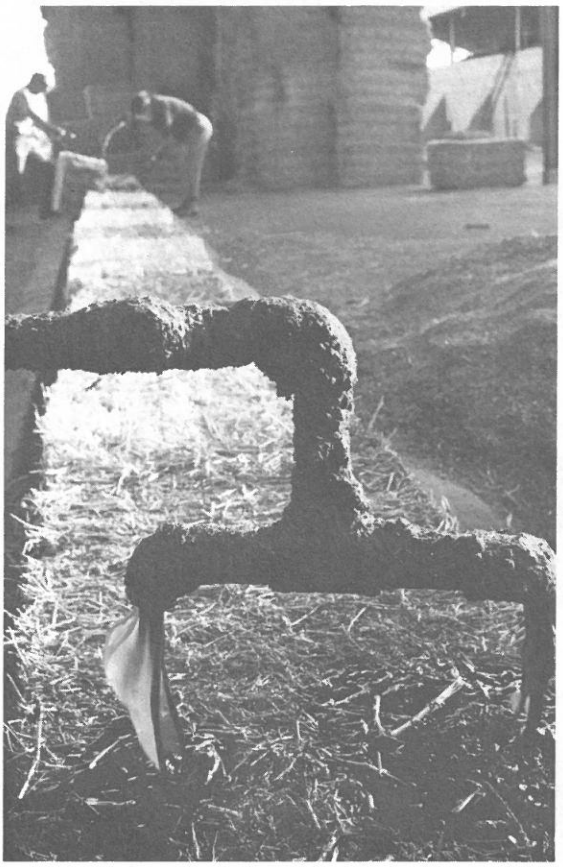
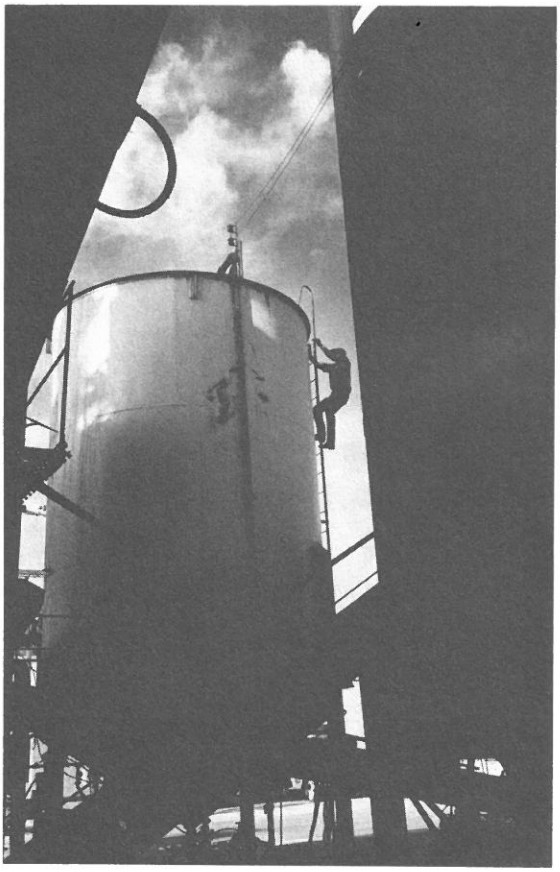
Fat is mixed with other feed ingredients in various ways. Here it is metered on to alfalfa pellets and sprayed on hay moving into the mill.





The fat storage tank has become a familiar sight at the feedlot and poultry ranch feed mill.

A major use for
the manufacture
primarily bar
1977 more than
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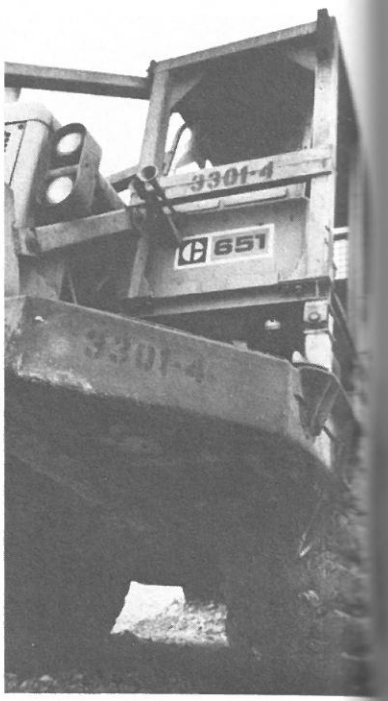


High grade tallow "split" into one of the many fatty acids used by industry today is used in the production of cosmetics . . .

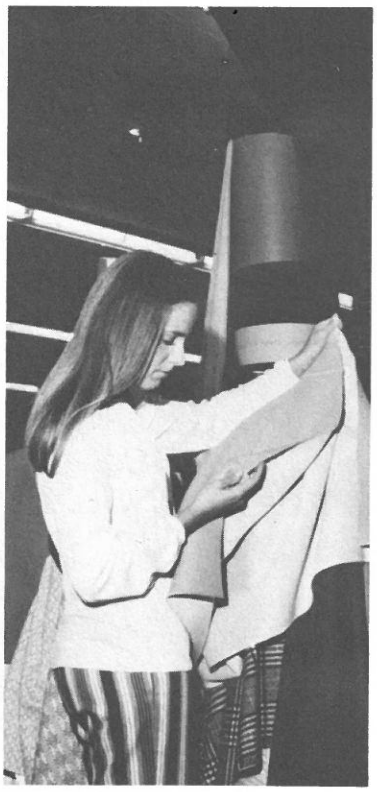
Paints . . .

and tires — large and small. About two percent of every tire on the road is stearic acid derived primarily from animal fats.

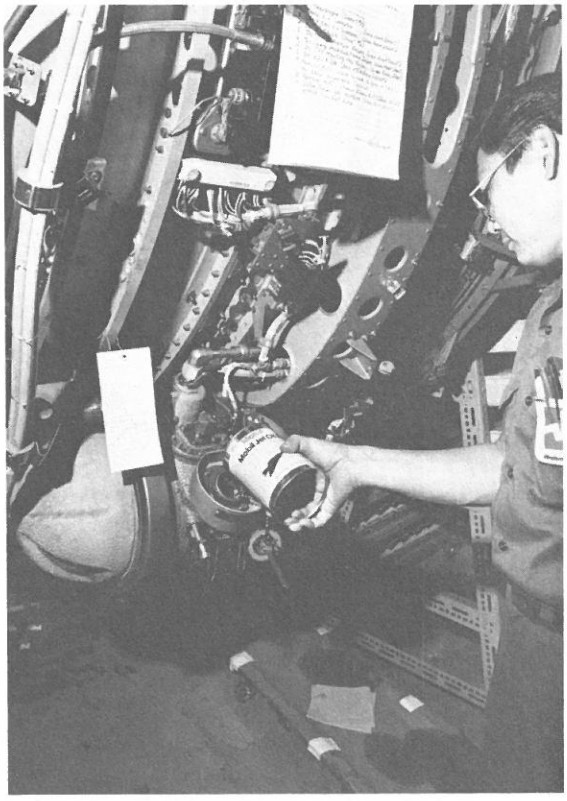
Fatty
Stearic

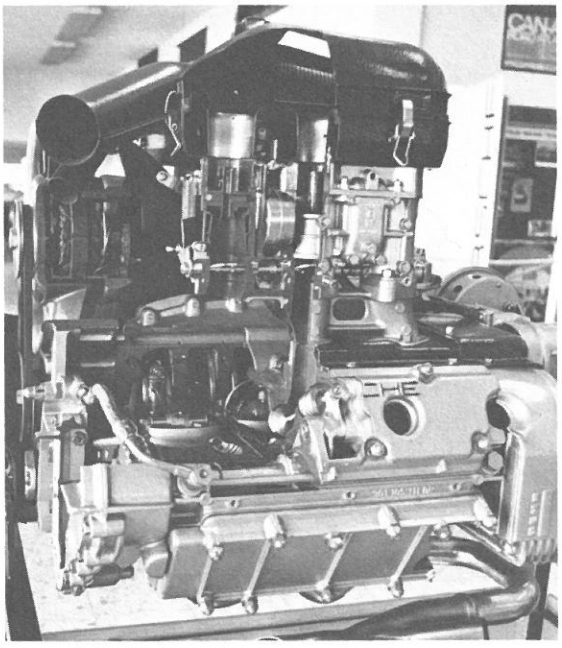
on the road is

A major use for tallow is the manufacture of soap — primarily bar soaps. In 1977 more than 700 million pounds went into soap production in the U.S.



Fatty acids are used in foodstuffs — ice cream and commercial baked goods among them. Stearic acid also provides a "dry lubricant" used in the manufacture of most fabric.





One of the newest uses for fatty acids derived from animal fats is in the manufacture of the so-called "synlubes" — a whole new family of synthetic lubricants for aviation and automotive use that promise extended engine life.

The dry pet food industry is emerging as a major market for the renderer.

Tallow has been found to be an important ingredient in the manufacture of concrete building blocks as a waterproofing agent.

acids derived from ure of the so-called amily of synthetic tomotive use that

n important in- concrete building

milk-fed veal carcasses is the fat content of whole milk or milk replacer.

At this point enter feed fat and meat/bone meal.

Initial experiments were organized with the objective of determining an ideal calorie-to-protein ratio for calf starters. Animal fat was added at five percent of the starter ration to intensify the concentration of energy. Then, meat/bone meal was added at different levels to vary the calorie-to-protein ratio. Feed efficiency and body composition were included in the study.

According to Gardner, the carcasses of the calves fed the supplemental fat were "very attractive because of more fat covering as well as a firmer and whiter fat." This stimulated comparisons with calves raised on whole milk because of the possible acceptance by the veal trade.

Holstein calves were selected for the tests, 24 grain-fed and eight milk-fed. Half of the grain-fed animals also were given a five percent animal fat supplement in their diet together with chopped alfalfa hay, rolled barley (barley was used only when the fat was not supplemented), meat/bone meal (five percent, 50 percent protein), molasses and salt. The fat was yellow grease stabilized against rancidity by inclusion of an antioxidant. Chopped alfalfa hay was included for "chewing." It was found that otherwise the calves turned to low energy straw or the shavings used for bedding. The calf starters and water were offered on a "free choice" basis.

The milk-fed calves were started on whole milk at 10 percent of body weight and progressively more milk was offered so that input was 15 percent at slaughter. Final live slaughter weights of 242 and 275 pounds were used for the grain-fed animals in two experiments (one evaluated on the basis of analysis of the bone-free meat and fat and one evaluated by a "taste test panel" to detect difference in odor, appearance, flavor, juiciness, character of juice and tenderness). Comparable weights of 238 and 270 pounds were used for the milk-fed calves.

In the final analysis Dr. Gardner found that the fat-supplemented starter rations and the whole milk conventional feeding both produced greater fat covering of the carcass than use of grain alone. The fat was firmer, flakier and whiter. Both visual and chemical evaluation showed no difference in intramuscular fat. The muscle tissue of the milk-fed calves was "only slightly paler" than that of the grain-fed animals and, it was pointed out, the muscle of the grain-fed (with fat supplement) animals was a "veal color," bearing no resemblance to the deep red of more mature animals.

Roasts from both groups of animals were evaluated by a panel of eight judges under the leadership of Dr. Marion Bennion of the BYU Food Science and Nutrition Department. Five rations were compared at each of four sittings with the panel members detecting no differences in any of the categories listed for judgment. A "shear test" also was used for verifying there was no variation in tenderness and it was disclosed that cooking losses by evaporation and dripping were unaffected by the feeding treatment.

"There has been a substantive change in veal calf production over the past 20 years," Gardner observed, "with vealers now older and heavier at slaughter. Milk and milk replacement rations have become extremely costly, thus, reducing veal production. Use of grain rations for veal production has been discouraged because of the presumption that an in-

ferior product would be produced."

"Our experiments appear to indicate," Gardner concluded, "that this assumption is incorrect and that distinct possibilities do exist for raising acceptable veal on fat-supplemented grain rations."

In a separate but related research project, Gardner, R. D. Kellogg and L. E. Orme of BYU conducted an experiment designed to study the comparative value of cottonseed meal and meat/bone meal as protein sources in calf starters. Methionine hydroxy analogue (MHA) was included in the study to ascertain if MHA may be a limiting amino acid in one or both of these protein supplements.

"Previous studies with calf starters," the researchers reported, "have concentrated on protein quantity with no consideration of protein quality. Meat and bone meal has been the protein supplement used in these calf starters. Because of exceptionally rapid weight gains, attention has now been directed to protein quality as a possible reason."

Simply stated, the experiment disclosed that average daily gains and feed efficiency favored the formula with meat/bone meal but without MHA. While MHA caused greater growth response when added to the cottonseed meal, it had the reverse effect when fed with meat/bone meal. A total of 40 Holstein bull calves were used in the experiment, divided into four groups. Cottonseed meal was added to the starters for one group; cottonseed meal plus MHA to one; meat/bone meal alone to one; and meat/bone meal with MHA to the fourth.

The researchers reported that "calves on the meat/bone meal ration ate well and averaged 13 percent higher in daily gains over a 180-pound growth range than animals on cottonseed meal rations. The difference was even greater during the first 65 pounds of growth. Calves on the meat/bone meal supplement gained up to 26 percent faster than those on cottonseed meal."

There also was a surprise in store for the researchers. It had been generally thought that meat/bone meal would not prove palatable for the calves. However, the reverse was found to be true.

Other research of recent vintage discloses that feeding animal fats to broilers, turkeys and swine appears to substantially improve their chances of surviving the trip to market. According to Dr. Conwell Johnson of the National Renderers Association, about one-half of fatty acids in animal fats are saturated and usually have a carbon chain length of C-16 or C-18. The fatty acids of vegetable oils are usually more unsaturated. When an animal consumes an excess of a fat, some of the ration fat may appear to be directly transferred to tissue fat, but the animal usually tries to convert ration fat to its own type of fat tissue. Since feed grade animal fat contains fatty acids similar to the intact animal, most of these fatty acids can be deposited intact on the animal tissue. This is one of the reasons why we observe a favorable carcass quality when animal fat is fed to broilers and turkeys.

Some fats, Johnson contends, have a "lower heat increment" and thus can be considered "a cooling ingredient" in the diet of single stomach animals such as the chicken, pig, dog or man. This is especially applicable in the shipment of certain livestock in hot weather.

Special shipping rations are needed during hot weather when broilers, swine and turkeys are shipped to market. Johnson feels that if shipping

rations with about 10 percent added fat were fed several days before loading and could save two percent shipping mortality and losses, then, with turkeys at 33 cents per pound, this would be worth $1,300 per 10,000 turkeys; likewise with broilers at 20 cents per pound, the savings would be about $1,333 per 100,000 broilers. These savings suggest this area of animal production needs further study. It also suggests an area where more animal fat may be used.

Studies conducted by A. J. Clawson and E. R. Barrick of the North Carolina Agricultural Research Station indicate that meat/bone meal at about six percent has been shown to give good results in rations for growing-fattening pigs. At this level, they said, the meat/bone meal supplied 20 percent of the total dietary protein.

Previous work at North Carolina State University had shown that a ration in which half the protein was supplied by corn and half by soybean meal provided excellent quality protein for rapid growth and that the growth rate was not significantly improved by supplying a higher percentage of protein from soybean meal. Now the question was what would meat/bone meal do for the growth rate. Since traditionally meat/bone meal usually represents a cost advantage over soybean meal, this could be important.

Feeding tests now were begun in which meat/bone meal was used to supply 7.5, 15.0 and 20.0 percent of the total dietary protein in corn-soybean meal type rations. The results were rewarding. Performance of the pigs was good on all diets with no significant differences in growth rate, daily feed intake or in feed required per pound of gain. Used at a rate of six percent in the ration, the meat/bone meal also supplied adequate calcium and phosphorus to meet dietary needs.

These represent only a handful of the scores of research projects conducted on a continuing basis by college and university agricultural departments, the U.S. Department of Agriculture, the livestock industries themselves, private companies and the rendering industry's Fats and Proteins Research Foundation to find better ways to make use of the resources available and to insure an adequate supply food for the world's population.

However, there is another area of research that must be pursued by the rendering industry itself if it is to realize the full potential of its products in animal nutrition. It is only within the last 25 years or so that the rendering industry has developed any significant degree of sophistication. Although always aware of the need to produce a quality product, the industry only recently has been faced with the requirement to turn out products with a high degree of consistency, particularly with regard to their nutrient composition. Attention now is being focused on this area due to the emergence of computer formulation. The computer deals only with a finite degree of exactness. Highly accurate values must be established and provided the computer for the protein content of a particular meat/bone meal, for instance. Similar values must be available on its calcium, phosphorus and amino acid composition. Dr. John D. Summers of the Poultry Science Department at Ontario's University of Guelph puts it in these terms:

"Some renderers are under the impression that animal products have a special place in ration formulations and that quality diets cannot be

produced without them.

"When one asks for information on the feeding value of meat/bone meal, it is still not uncommon to receive an answer that relatively high levels can be used with good success. With the sophistication used in feed formulations today and the pressure on the economics of production, such information is of little value to the feed manufacturer.

"What the feed formulator requires is information on nutrient composition, availability of nutrients and any other information that would allow him to assess the nutritional worth and acceptability of a product to various classes of poultry. Armed with this information, the computer will quickly decide on the most economical level that can be used in various poultry diets."

According to Summers, a product such as meat/bone meal which contains a broad spectrum of nutrients, will gain increasing favor as uniformity is increased and all nutrients that it contains are considered with computer formulation. In the future, he says, more emphasis will be placed on nutritional value of a feed ingredient in meeting specific nutrient requirement of poultry than is the case today.

"If properly evaluated for all the nutrients they contain," he points out, "rendering products will continue to compete favorably with other feed ingredients in meeting the nutrient requirements of poultry."

They are well suited to the increased sophistication that is continuing in the area of feed formulation and the feeding of poultry, Summers maintains, calling out especially animal fat as a concentrated source of energy and feather meal as a concentrated source of protein. Implicit in his observations, however, is the requirement for the renderer to place greater emphasis on finite analysis of his product either through ultra modern in-house laboratory facilities or by employing a reliable, up-to-date independent laboratory. The type of additional testing that must be performed and the depth of analysis also appears to call for a significantly greater expenditure on the part of the renderer. This in the face of other escalating production costs does not qualify as "good news" to renderers, but nevertheless such trends cannot be ignored.

For example, Summers points out an area that he contends has been given "only limited attention" in the past. It is the amino acid composition of meat/bone meal.

"The nutritionist must know," he declares, "the amino acid composition and the variations to be expected if he is to make efficient use of this product. Renderers could be criticized in the past for not providing enough information on this point."

Summers asserts that with our present-day knowledge of the birds' requirements for specific nutrients, feed ingredients are evaluated on the basis of their ability to provide these specific nutrients at competitive costs. Hence, meat/bone meal must compete with other sources of protein, energy and minerals.

"Renderers have not been as quick," Summers adds, "in changing their thinking to the modern-day trend in feed formulation as have the suppliers of some of the other feed ingredients."

Among the internal industry research products completed in recent years was one conducted under the auspices of the Fats and Proteins Research Foundation to determine what effect season or geographic area

of production had on the composition of by-product protein meals.

Heretofore, largely because the nutritional constituents in these products have been determined by many different organizations on materials from different sources prepared by varying processes, it was generally felt that there were wide variations in the nutritional quality of the products.

Over an extensive period, a total of 296 samples from 53 different rendering plants from various parts of the nation were sent to the Wisconsin Alumni Research Foundation laboratory for analysis. Cooperating plants were asked to provide samples at four different times of the year—May, August, November and February.

While the results of the survey emphasized the need for producers of animal by-product protein meals to increase their efforts to produce products that are uniform in components of nutritional significance, it also was concluded that meals produced by independent renderers and meat packing companies have essentially the same composition and the samples analyzed show that many producers of animal and poultry by-product meals produce products of uniform composition. The comprehensive data compiled as the results of the FPRF survey is made available to the feed industry.

An ever-increasing market for meat/bone meal and another way in which the renderer completes the food chain is in providing pure, wholesome material for pet food. You might think rendered products constitute a major ingredient in canned dog and cat food. Not so. It is in dry dog food that some 488 million pounds of meat/bone meal was used in 1975 along with 17 million pounds of poultry meal in dry cat food. The pet food industry in the United States tripled its sales between 1965 and 1974. By 1976, an estimated 3.8 million pounds of dry dog food was being consumed and it is predicted this figure will go to 6.1 million by 1986. Since meat/bone meal is a major ingredient in dry product—ranging from 30 to 60 percent by volume depending on the manufacturer—the importance of this contribution of the rendering industry becomes self-evident.

In review it can be seen that the rendering industry plays a unique role in our food chain. It represents the link in that chain that closes the loop annually channeling billions of pounds of otherwise unusable (in the sense that it is considered inedible by humans in its original form) meat, bone, fat and tissue back into our livestock industries in the form of the energy and nutrients needed to produce still more food for a hungry world.

Few Americans today are unaware of the popularity of poultry meat, particularly in the form of a "convenience food" available ready-to-eat at the corner fried chicken stand. However, relatively few probably are aware of the role poultry—turkey as well as chicken—plays in our modern food chain. Even fewer understand the importance of rendered products in the production of poultry and eggs.

According to estimates of the U.S. Department of Agriculture, world production of poultry meat was in the neighborhood of 34.6 billion pounds in 1976. More than a third of that, some 11.8 billion pounds, would be produced in this country. Along with the poultry meat, world production of eggs—also an important source of protein in the human diet—would top the 305-billion mark with the U.S. accounting for about 21 percent or 64 billion. It is interesting to note, that on a bird-for-bird basis, the United

States produces approximately 40 percent of the world's broilers and 58 percent of the world's turkeys and it exports 386 million pounds of poultry meat to other nations.

With the exception of those few countries where ethnic considerations dictate the kind of meat eaten, beef certainly has become the most sought-after. But, beef is and will remain relatively expensive compared with poultry meat. Thus, poultry is becoming increasingly important as a meat source particularly in view of a tightening world economy aggravated by the constantly increasing cost of energy.

Prior to World War II the average farmer raised only enough poultry to provide his family with meat and eggs and even the largest chicken ranches housed only 10-to-20 thousand birds. Egg producers ran somewhat larger flocks of laying hens. Chicken available to the consumer fell into two categories—the stewing chicken, usually stringy and on the tough side; the fryer, a plumper, tenderer bird sold at a premium price. Today the stewing chicken has all but disappeared from the market and the fryer has given way to the "broiler"—an even plumper, tenderer bird which is generally considered a delicious, nutritious and inexpensive meal. Turkey, which until recent years was available only at Thanksgiving and Christmas, now is much in demand as a year-around food.

THE CONNECTION 6

It has become popular in recent years to talk of the "connection." Although the term first came into use on the context of the often circuitous route taken by some illegal goods from the producer to the consumer, it now also is used to describe the route and method by which almost any product travels from its source to the point it is consumed or used in the production of still another product.

In this sense, let's look at the renderer's connection—a route that makes use of trucks, trains and ships and which sees tallow and animal proteins pass through many hands between producer and consumer. And if we are to trace that connection, we should have a better understanding of a key word, "commodity."

If rendering is indeed the "invisible industry," then it's probably appropos to call that industry's products—tallow, grease and meat/bone meal—the "quiet commodities."

This is in contrast to those which are not so quiet—wheat, corn, oats, sugar, silver, cotton, lumber, broilers, eggs, cattle, soybeans, hogs, wool and about 15 more which are traded through futures contracts every day—making some people richer and about an equal number poorer.

Commodity trading is a big business in which there are two basic classifications of traders. One is the businessman—a farmer perhaps or a producer—who produces or markets the commodities. He is in the commodity market for one reason: to protect himself from fluctuations in the prices for his products. Typically he will hedge by selling short in the future market. In selling short he is agreeing to buy and deliver at a future date commodities equal to his anticipated inventory or output.

When the time arrives for him to sell his own inventory or output, he is protected from loss resulting from price fluctuation. If the commodity price has fallen since he made his hedge, he will get an offsetting profit from his short sale. If the commodity price has risen he will make more on the sale but this additional profit will be offset by the loss he incurs in covering his short position.

The second classification of trader in the commodity market is the speculator—someone who is probably not involved in production or processing of the commodities at all but simply attempts to make money by buying when he believes prices are low and selling when they are high.

Because margin requirements—the amount of cash as a percentage of purchase price—are quite low in commodity trading there are opportunities for large, quick profits and large, quick losses. Obviously it is not an investment game for the naive.

For example, a unit of trading in wheat futures is 5,000 bushels. At a typical price of $2.25 per bushel on a futures contract, total price for the contract would be $11,250. With a 10 percent margin requirement, the

speculator can commit on this investment with only $1,125 plus commission of $30.

Now the fun. Assume this purchase was made on March wheat. But the Russians unexpectedly cancel a big order. The price falls five cents a bushel—only five cents. You've lost $250 or more than 20 percent of your investment. A drop of 20 cents a bushel and your investment is wiped out. That's a drop of only 10 percent in the wheat; but a drop of 100 percent in your investment.

That's a sample of what it can be like in the conventional commodity market. It's a different world, however, for the businessmen who trade in rendered products.

Thirty years ago there was no trading, in the normal sense, at all. Procter and Gamble announced its price for tallow each morning and that was the market. In those days renderers sold almost their entire output of tallow to the soap makers.

There were tallow brokers, however, as there are today. These companies make a business of locating buyers on one hand and sellers on the other—a particularly valuable service for small companies that do not have a marketing department of their own.

The open market for rendered products developed with the rise of detergents and the consequent drastic reduction in production of natural soap—a post World War II development. Renderers were forced to seek new markets for their products and they found them.

Asian and European countries needed tallow for soap as well as for diet supplements. Today 50 percent of U.S. tallow output is sold to foreign users—the Pacific Coast renderers supplying the Asian market, the Midwest and East selling primarily to Europe and South America, though occasionally some Midwest tallow is sold to Asian customers also and West Coast renderers sell to South America.

How does the tallow market function? Like other commodities, it's basically supply and demand which determine the price. Unlike other commodities, however, there is no central market—such as the Chicago Board of Trade. There was an effort to establish a tallow commodity market in Chicago in the 1950's but it was abandoned due to lack of volume.

Rendered products are sold and resold—and price is thus determined—by daily telephone negotiations. Hundreds of telephone and Telex calls to and from producers, other buyers, brokers, dealers, and in the case of West Coast transactions, the Japanese trading houses, establish the current market price and sales volume. It is admittedly cumbersome but the volume itself makes any really efficient system uneconomical at this time.

The Japanese trading houses are the dominant buyers in the West Coast market now. They buy not only for resale in Japan but for users in Korea and Taiwan and other Asian countries.

The tallow market is not independent of other commodities, of course. The user has the option of using soybean oil, coconut oil, fish oil or palm oil—thus tallow prices must remain competitive.

Unlike other commodities, tallow prices tend to remain reasonably constant. Sales typically are made for delivery two months hence, a sort of futures contract for the overseas market. This does make speculation a

possibility and some companies do it—anticipating a change in the market.

However, such dealing is relatively minor and, unlike the market for other commodities, it is limited to the professionals in the business. The general public has no place in tallow. The fact is there simply is not enough free production to encourage speculation.

Tallow markets are regional, of course, not national. There is little variation in the day-to-day price throughout the U.S., but often the variation over a period of months can be significant. Variations, when they occur, reflect fluctuations in supply and demand in a particular market—but such conditions disappear quickly.

For instance, as of December 1977—prices for bleachable fancy tallow, the top grade, were 15.92 cents per pound. The low in that year was 15.67 cents; the high 20.29 cents.

Sales to domestic users vary to the extent that usually they are made only up to 30 days in advance rather than two months on exports. Trading in products for these markets—particularly bleachable tallow, feed fat, grease, meat/bone meal—tend to be more active simply because there are more buyers in the market, feed companies as well as feedlot operators and poultry raisers.

There is something else significantly different about the rendering industry and its customers—virtually all orders and buys are made on a verbal basis.

A formal contract is uncommon—appropriate to be sure for the quiet commodities. Personal integrity is extremely important.

Now that we have a better feel for commodity trading, of rendered products in particular, let's trace the connection.

If one had to put his finger on the single most important vehicle or mode of transportation figuring in the renderer's connection, it would have to be the motor truck. Unfortunately, accurate, timely statistics on the exact number of motor trucks used by this industry are non-existent. But, meaningful figures can be computed by extrapolation based on a sample survey conducted by *Render*, the national magazine of the rendering industry, embracing a small but typical cross section of the industry.

Utilizing a trucking fleet of some 25,000 units (including tractors, trailers, tank trucks and route trucks), U.S. renderers bring in raw materials and their finished product, at least part way to the consumer.

With an industry that is moving as fast as rendering and requiring the constant flow of raw materials and finished products (rendering trucks spend 12 hours a day, five days a week on the road, averaging as much as 50,000 miles per month), the trucking operation is one of gargantuan size and cost. The trucking operations officer for one of the largest rendering operations estimates his company spends $1 million annually on its trucking operation.

Almost all of the truck fleets are owned by the respective rendering companies or specialized trucking firms. Some trucks are leased but the benefit of owning the trucks is that it allows for a constant flow of material, especially if one handles a great volume.

Maintenance, the bane of any mechanized industry, also takes its share of expenses in the renderers' trucking operations. In excess of $5 million is spent by renderers each year for vehicle maintenance alone. Nearly 70,000

tires are used every year by rendering trucks at an expenditure of more than $5 million.

The trucks themselves are replaced on the average every five to eight years. Route trucks usually are replaced sooner than tankers or tractors. Engines usually are replaced after 100,000 to 150,000 miles for gasoline powered units and after 300,000 miles for most diesel units.

Fuel consumption is high for the truck fleets. More than 7 million gallons of fuel are consumed each month at a monthly cost of about $4.2 million. Trucks average 12 hours a day on the road carrying an average 20,000-pound load.

Of the tractors used, the numbers are rather evenly split between the two-axle and three-axle tractors while the number of two-axle route trucks outnumbers three-axle route trucks almost two to one.

Operational units (tractors, trailers, tankers and route trucks) are cleaned daily using a system of high pressure steam. Many of the tankers and wet tanks used to haul tallow are cleaned after each run, some after several consecutive runs during that day.

It's important to see that the tanks are kept clean when shipping tallow; there is a great possibility of downgrading the material if the tanks are not cleaned.

Most truckers in the rendering business clean the tanks after each load of fats. Their steam cleaning racks work night and day.

Wear and tear on the tanks is heavy what with the constant loading and unloading of hot tallow and subsequent steam cleaning on a daily basis. Life of the tanks are cut by approximately 20 percent due to the constant transfer of material and cleaning. Strain on the metal is worse in the winter due to the constant change of temperature. Life of a trailer depends upon the make but the average is around eight to 10 years depending on its use and the area it is used in.

It is estimated conservatively that the rendering industry spends some $20 million annually just on its trucking operations. Trucks pick up the raw materials at the packing plants and slaughter houses, supermarkets and butcher shops. Trucks deliver tallow, feed grade fat and animal protein to local and regional consumers and represent an integral link in the connection between the rendering plant and the liquid bulk terminals situated in major ports on the nation's coasts and the Great Lakes where oceangoing vessels take on these products for delivery to overseas consumers.

On the surface, one might think that a trucker is a trucker is a trucker. But there are some aspects of hauling rendered products that set the job apart. By and large, these truckers work longer hours, are better paid and demonstrate a seemingly stronger sense of loyalty to their employers.

To get a better feel for this particular link in the connection and for the men who maintain it, let's take a typical renderer trucker and look at a day in his life from the vantage point of the right seat in the cab of his 18-wheeler.

On a hot July morning you arrive at the Los Angeles plant of Peterson Manufacturing Co., at 7:15 A.M. Herb Garrison, the 17-year veteran with Peterson, is shoving off on the 530-mile run through the bleak, 100-degree-plus Southern California expanse of desert and rugged volcanic outcroppings.

Firing up the 335-horsepower Diesel engine, he eases the rig onto the scales. Tractor, trailer and 48,000 pounds of feed fat weighed out at 73,200 pounds. The trucking supervisor hands Herb his bill of lading and waves him out of the yard.

Garrison, a medium sized gent; quiet, soft-spoken (most of the time); and obviously completely at home in the big cab-over-engine tractor, handles the wheel smoothly and seemingly without effort as the rig (we are pulling a "long" trailer) snaking in and out of traffic enroute to the outbound Pomona Freeway.

Back on the road Garrison heads south along the Salton Sea (passing signs that say "Elevation minus 200 feet") on the second leg of the run to Peterson's Brawley plant in California's Imperial Valley—one of the nation's largest cattle feeding regions. At Brawley, the delivery instructions have been changed and the load is to go 20 miles further south to the McCabe Cattle Co., El Centro feed lot. This will add nearly an hour's driving time to the day's trip which is to end another 300 miles to the north at the company's Henderson, Nev., plant late that night.

Indio, Calif., and break time at the Truckadero. It is 10:45, too late for breakfast and too early for lunch by usual standards. You pay your money and take your choice—Garrison chooses lunch.

At McCabe the lines are connected to the fat tank. The pumps empty the trailer in just 30 minutes. Ready to leave, a phone call catches up with Herb. Back to the Brawley plant to pick up some company mail going to Los Angeles before he can begin the long trek northward.

At 4:20 P.M. and back in the cab. The fuel is replenished—107 gallons pumped into the 140-gallon tank—for the six-plus hours ahead. Fuel stops are few and far between along back roads through places like Glamis, Blythe, Vidal, Needles and Searchlight. Traffic also is light, in fact almost non-existent. On the 89-mile stretch between Brawley and Blythe, only seven vehicles. During the next 200-odd miles, only about 20 more.

That first 89 miles along California 78 East and North from Brawley is a study in contrast. The lush, green meadows of the Imperial Valley gradually give way to mesquite, cactus and chapparal-dotted mounds of greyish earth. Then even this vegetation begins to peter out. The grey mounds become long, softly rolling, yellow sand dunes ("a great place to shoot a Foreign Legion movie.") Next, preceded by signs warning of "dips," the "Sahara" suddenly turns into the "moon." The road twists and dips like a huge roller coaster through grotesquely jagged spires of volcanic rock. Then, almost like magic, it is green again as the road begins skirting acres of bulrushes, reeds and tall grass marking the bottom lands of the lower Colorado basin.

If anything, the road—U.S. 95—north from Blythe is even more desolate except for an occasional vacation camp where it still parallels the Colorado. It is 6:40 P.M. as the truck pulls into the truck stop at Vidal Junction, a crossroads literally in the middle of nowhere. Coffee, a chicken-fried steak and a few minutes rest.

Off again at 7:10 P.M. North from Vidal Junction—some more country that looks like the lunar landscape. The setting sun angles into the cab from the left and ahead making it increasingly difficult to see the road. The windshield by now is pockmarked with spattered insects, aggravating the low angle problem.

Dark envelops Garrison as he passes through Needles. It is pitch dark. No moon. No lights on the horizon. No traffic. Herb no longer is lounging comfortably back in his seat. Fatigue now shows on his face, dimly illuminated by the panel lights. Even without his load of feed fat he still has a 25,000-pound juggernaut to control on a dark and narrow road. He's tired and knows it but the end of the route is just over the next ridge. Searchlight and the lights of Boulder, Nev., pass by—downhill side of the ridge. In the distance the myriad of flashing lights that is Las Vegas. Closer, the lights that mean Henderson and the Nevada Star Rendering plant.

It's 9:40 P.M. when the tractor-trailer rolls into the yard. The driver's day isn't over, however. If he waits until tomorrow to take on the load of tallow for Los Angeles it will have congealed in the filler line (the tallow begins to set up at 90 degrees and the nights get cool in the desert even in mid-summer). This will make the load difficult to load plus it will be cooler and more difficult to unload when he reaches L.A.

Now in the holding tank it still is about 145 degrees. The trailer, like a huge vacuum bottle, will keep it at at least 140 degrees for up to 24 hours. The answer is to load tonight. There is no help. There is little light. Wearily Garrison climbs up on the tank, fits the filler hose into the tank and turns the valve. For another 30 minutes or so the tallow gurgles into the trailer. The trailer creaks and groans in protest as the load increases. Finally, full again. Herb Garrison can hit the sack.

You learn a lot traveling with the Herb Garrisons. Renderer truckers make good money. For instance, an "A" route driver like Herb (this is a term used to differentiate between the routes on which the company's products—tallow, feed fat, meat/bone meal, etc.—are delivered from those on which his raw material is picked up) can average $20,000 a year by putting in a lot of hours and a lot of miles. They are paid a combination of hourly wage and mileage—hourly in town and by mileage on the road. Some drivers have been known to earn as high as $30,000 in a year. To do that they literally have to drive during every minute they aren't getting their compulsory rest (like airline pilots, they must rest for a set number of hours before taking the wheel again and the length of time they can drive in one stretch also is regulated by law.)

Route drivers—those who handle the trucks, many of them especially built 10-wheelers, that pick up the raw material and transport it to the rendering plant—work shorter hours but their work is dirtier and often physically more demanding. Lifting and dumping 50-gallon drums of butcher shop bones and fat into the truck can beat even a strong man down by the end of the day. These men also are well paid, however, and voice a real satisfaction in their work.

Still another element in the renderer's connection is the nation's railroad system—specifically the thousands of railroad tank cars used to transport liquid commodities. Those used for tallow and feed fat have coils of pipe buried in their bellies through which steam can be pumped keeping the fats and oils in a fluid state to facilitate pumping it overboard at the destination. Many large renderers lease whole fleets of these cars on an annual basis, insuring that a car is available when it is needed while others take their chances along with the many other users who have liquid commodities to ship.

The United States exported some 2,314,000,000 pounds of tallow and grease in 1976—enough—at 56 pounds per cubic foot—to pave a 40-foot highway to a depth of 12 inches for almost 200 miles or enough to fill 308 million one-gallon jugs. That tallow and grease was worth more than $400 million, an impressive contribution to the nation's troubled balance of trade.

A support industry which facilitates this huge export program—the liquid bulk terminal industry—itself constitutes a multimillion dollar activity. That industry today is in very much the same boat the rendering industry was a few years back—there actually are few valid statistics available to reflect the magnitude of the terminal industry but if just the amount of renderer's product handled is any indication, it is of tremendous size. In addition to tallow and grease, the liquid bulk terminals handle untold millions of gallons of other liquid commodities.

Since there are few facts available reflecting this industry as a whole, a composite picture must be constructed from those available on representative terminals on the nation's three coasts—the Atlantic Seaboard, the Gulf of Mexico and the West Coast. Some 30 percent of tallow and grease exports emanate from the Atlantic Coast, a little more than 35 percent from the Gulf, just under 25 percent from the West Coast and about 10 percent from Great Lakes' ports.

While most liquid bulk terminals handle a variety of commodities, for the purpose of this look at the rendering industry, we'll be concerned only with those that handle tallow and grease. What, then, constitutes a tallow terminal?

First—it has facilities to receive bulk tallow and grease by railroad or highway tanker, store the commodity and put it aboard ship. This might be considered the basic terminal capability, a minimum so as to speak. Inherent in this is the capability to maintain and/or heat the tallow to facilitate its handling since it is the nature of the commodity that it solidifies at ambient temperature. Also inherent in this activity is the capability to guarantee that no contaminant will be permitted to enter the tallow either during storage or transfer.

Second—more sophisticated terminal facilities provide special services to the shipper to prepare the tallow for shipment—blending, refining and bleaching.

Third—since some tallow (this amount is steadily decreasing) must be shipped in steel drums because the consignee does not have available bulk storage facilities at the destination port, some terminals have the capability to drum the commodity.

Fourth—for edible tallow, USDA-inspected facilities are provided.

A refinement available at many terminals are scales capable of weighing both tank cars and tank trucks. This provides both shipper and customer with a much more accurate means of measuring the exact amount of tallow shipped and received. Where railroad and truck scales are not available, it rests with the surveyor to gauge the ship's tanks as a means of insuring that the volume shipped meets the contract amount.

Tallow terminal facilities fall generally into two categories—those operated by a major renderer and the "independents"—those not associated directly with the rendering industry. In most instances, renderer-owned terminals do not offer public storage while the in-

dependents, of course, depend on providing storage, refining, bleaching and blending facilities to the public.

Commercially-owned, independent bulk liquid terminal, storage and distribution companies are located principally on waterways. These operators serve the users of bulk liquid petroleum and petroleum products, chemicals, animal fats and oils, molasses, vegetable oils, etc., and interface with vessel, rail, truck and pipeline transportation modes.

Representative companies operating terminals include: New Haven Terminal, Inc., New Haven, Conn.; Lake-River Terminals, Inc., Berwyn, Ill,; Intercontinental Terminals Co., Robertson Distribution Systems Co., Robertson Terminals, Inc., and South Coast Terminals, Inc., of Houston Tex.; International Tank Terminals, Ltd., New Orleans, La.; Norfolk Oil Transit, Inc., Norfolk, Va.; Southland Oil Co., Savannah, Ga.; General American Transportation Corp., Chicago, Ill.; Ocean Terminals, Blue Bell, Pa.; Paktank Development, Inc., Princeton, N.J.; Fore Terminals, Inc., Alameda, Calif.; Ergon, Inc., Jackson, Miss.; Bayonne Terminal Warehouse Corp., Bayonne, N.J.; and Pacific Molasses Co., San Francisco, Calif.

Typical of these companies is Fore Terminals, Inc., with headquarters in Alameda, Calif., and facilities both at Alameda and Tacoma, Wash. Fore, in the San Francisco Bay area, has a capacity of more than 12.5 million gallons; a bulk loading system capable of handling 112,000 gallons a day; drumming facilities capable of turning out more than 1,000 drums a day; and blending, bleaching and refining systems capable of processing 1,400 tons each week. At Tacoma, the company has 3.5 million gallons of storage capacity. Drumming facilities are available. Bulk loading can be performed at a rate of 175 tons per hour. Although no refining is done at Tacoma, the facility can bleach at the rate of 1,250 tons a week. According to Lou Fore, president, the Tacoma and Alameda facilities represent a "high degree of automation for unloading, loading, processing and transferring commodities."

"From the time the commodity arrives at the terminal," he says, "stringent handling procedures insure no contaminants are added and constant sampling and analysis by in-house laboratories assures strict quality control."

Like many of the terminal companies, Fore is a family-owned enterprise. It is an outgrowth of a one-truck transportation business established by James Fore, father of the current president, more than 30 years ago. Fore Trucking Co., Inc., is an integral part of the family business today.

Also family-owned is Hudson Tank Storage, an important terminal serving the East Coast. The company, also called Hudson Tank Terminal, was incorporated in New Jersey during February 1946.

Terminal facilities are located in Weehawken on the Hudson River and near the entrance to the Lincoln Tunnel. They consist of 120 storage tanks ranging in size from 15,000 gallons to 500,000 gallons with a total terminal capacity of 15,000,000 gallons.

Hudson has berthing facilities for barges and shallow draft vessels to service clientele engaged in the import/export commodity trade. Railroad sidings are serviced by the Penn Central with usual connections to other railroads serving the east. The New Jersey Turnpike is approximately one

mile from the plant.

The major portion of Hudson's total capacity is utilized to service about 40 clients who import and/or export vegetable oils and animal oils. The balance generally is used to service clients who store industrial and/or process chemicals.

The facility includes the necessary pumping and piping systems for loading/unloading barges, tank cars and tank trailers. High pressure steam is used for heating various commodities through tank coil systems. Some tanks have interior painted linings—all are equipped with coils—all can be put into active "bonded" status for U.S. Customs Control.

Currently, the corporation is owned and operated by Albert Mogerley and his brother, Gordon, as a public warehouse in the Port of New York area.

Pumping and piping systems provide for "private" handling of commodities from top white tallow through the various grades to grease. Independent systems provide for receiving various commodities from refined vegetable oils to acidulated soap stock (foots).

Parcels of the products, once accumulated, are tested for quality and then prepared for transshipment via barge to the vessel. Strict control over handling methods assures the exporting firm of its ability to meet all "minimum/maximum" specifications.

"Sensitive" commodities are stored in lined tanks which prevent contamination by contact with oxidized carbon steel. Many lined tanks have stainless steel, aluminum or nickel heating coils. Stabilizers can be added at the time the product is pumped into storage. All tanks can be circulated or blends made through physical transfer of one grade to another. Bleaching and refining are not performed by Hudson; however, refined and/or edible grades of fats and oils can be blanketed with nitrogen. Drumming facilities are available through two automatic drum filling lines although Hudson has not drummed tallow for export in recent years.

Not only is International Matex Tank Terminals, Ltd., of New Orleans a major force in the liquid terminal industry on the Gulf Coast, but it also is important to Asian trade having terminal facilities in Chittagong, Bangledesh, Karachi, Pakistan; and Seoul, Korea.

IMT has completed its fourth decade of operations in the terminal field. Since its modest start, it has become the largest independent bulk liquids terminals operations in the United States, with two giant facilities in the port of New Orleans, Avondale and St. Rose terminals, and one in Mobile, Ala., in addition to those overseas.

Beginning with a small petroleum tank farm at Avondale, La., the overall capacity of IMT has grown to approximately 7 million barrels. Although the largest percentage of this capacity is devoted to petroleum products, tallow, animal fats and vegetable oils continue to be an important sector of IMT's annual throughput, and the very latest equipment and scientific methods for handling these products are incorporated in the terminals.

In tallow and animal fats, the IMT terminal at Avondale is the "flagship of the fleet," so to speak. It has specialized in this field for many years, and employs every type of device and equipment for servicing the varied products which require delicate handling, precise measurements and spotless housekeeping.

At Avondale, as in all IMT terminals, customers can be serviced from, and into, every type of transportation required, such as, rail, trucks, barges and ships. Avondale can handle 80 rail cars at one time. The deep-draft docks can handle "any ship now operating in the Mississippi River." In addition, IMT leases storage tanks, and performs drumming, blending and, at St. Rose, canning, as required.

Avondale handles all grades of tallow, such as extra fancy tallow, "A" tallow, special tallow, bleachable fancy tallow, choice white grease, yellow grease, etc. At Avondale, IMT has a total capacity of 160,600 short tons which can be devoted to tallow and animal fats, edible and non-edible.

In Karachi, the IMT terminal accommodates 25,000 short tons of tallow and animal fats; in Chittagong, 28,000; and in Korea, 22,000. Neither Mobile nor St. Rose are handling any appreciable amount of animal fats or tallow at this time.

We must remember that half of all the tallow produced in the United States is exported. No great change in this situation is presently foreseen. There will be reductions periodically as well as increases, but they don't expect anything to upset drastically this 50-50 ratio in the foreseeable future. This does not, however, take into account major upheavals, such as wars, bankruptcy of importing nations, extreme weather conditions, and the like which could, of course, effect changes; however, under normal conditions, this ratio should prevail. IMT is figuring on the tallow and animal fats industry to continue as an important part of its business.

Baker Commodities, Inc., of Los Angeles, is a major renderer that has established its own large terminal facilities. Baker currently operates major terminals in Long Beach and San Francisco and recently joined with a Korean firm to establish a terminal in Korea.

Baker's 22 tanks presently located between Berths 30 and 32 in the Long Beach Harbor provide a capacity of 36 million pounds. In San Francisco at Pier 92 on Islais Creek, Baker presently has a capacity of 20 million pounds. For some time Baker has handled tallow for other renderers at its San Francisco terminal.

For the better part of two decades the terminal operated by Mortimer & Wallace (the Wallaces, Howard and Howard, Jr., are principal owners today) has been a mainstay in the tallow export trade from the Los Angeles area. Situated at Berth 174 in the Los Angeles harbor, the M&W has a capacity of 8,000 tons.

As in the case of most modern terminal facilities, M&W can handle shipments arriving at the harbor either by rail or truck. The terminal offers refining, blending and bleaching services to its customers and is one of the few major facilities still doing substantial drumming. In recent times, in fact, M&W was called upon to handle one of the largest shipments of drummed tallow ever to leave the West Coast—11,000 barrels—all drummed and shipped in a record 10-day period.

Two parallel pipelines/pumping systems provide the capability to load two separate products simultaneously (the terminal can load more than 500 tons an hour). One of the two systems is configured with stainless steel pipe and fittings meeting USDA requirements for the edible tallow trade.

Each year more than a quarter million tons of tallow and grease are shipped through terminals situated on all three coasts—East, West and Gulf—operated by Jacob Stern & Sons, Inc. If Stern terminals are not in

themselves unique, then the company surely is. It has been around a long, long time. In fact, it was 21 years ago when, then President, Dwight D. Eisenhower wrote:

"I have learned that the corporation of Jacob Stern and Sons will celebrate its one hundredth anniversary on January 5th and I am pleased to congratulate its employees and management. Under the direction of one family during its entire history, Jacob Stern and Sons has maintained a splendid record of public service."

Today, Jacob Stern & Sons is a multi-faceted agricultural commodities trading and processing company. It operates terminals for its own products in Philadelphia, Houston and Seattle and provides public storage and terminal services at both Houston and Seattle. Stern terminals are among the most modern in the world. All of them have fully equipped laboratories to provide high level quality control. Each terminal has facilities for drumming (when required), blending, bleaching and refining. For the convenience of its customers, the company also maintains a West Coast branch of its executive offices—in San Francisco.

Final link in the renderer's connection, at least insofar as his export trade is concerned, are the oceangoing vessels—U.S. and foreign flag carriers—plying the sea lanes from U.S. ports to customer countries in Europe, Africa, South America, the Far East, Latin America, the Caribbean, Canada and the Middle and Near East.

In 1976, U.S. tallow and grease were exported to 66 nations. Our biggest customers were Egypt at 240 million pounds, Japan at 227 million, Korea at 203 million, The Netherlands at 181 million, West Germany at 130 million, the United Kingdom at 105.5 million and Algeria at 101 million pounds. Export figures on animal proteins are not readily available, but they are significant.

Traditionally, animal fats and oils (animal proteins were not traded internationally until recently) were shipped in steel drums. With the advent of liquid bulk terminal facilities in major foreign ports, the bulk of these commodities began making the ocean voyage in tankers or in the so-called "deep tanks" of freighters and passenger lines. In recent years containers for liquid commodities (as well as finely ground solids such as meat/bone meal) have been developed. So far, however, container shipment of fats and oils have not made a significant headway.

Drums still are used where the fats and oils must be shipped to a destination port that does not have bulk liquid terminal facilities. Such orders usually are relatively small although within the past few years orders requiring as many as 11,000 drums have been shipped.

Like the railroad tank cars and the highway tankers, vessels handling tallow and feed fats are equipped with the heating coils needed to maintain the material at a constant temperature over an extended period. This is necessary to prevent deterioration in quality as well as to keep the material in liquid state so that it can be pumped out easily on arrival at the overseas terminal.

A little known but extremely critical service performed by a relatively small group of experts is surveying. Marine surveying firms place their representatives aboard the vessel being loaded to confirm the quantity of the commodity placed aboard and to take samples which, in turn, are analyzed in a laboratory to determine the quality (in terms of the buyer's

specifications) of the commodity. At the destination a similar operation checks both the quantity and quality of the product. Surveying firms are independent of both seller and buyer and thus provide an objective medium for establishing any responsibility on the part of the carrier for loss of material or deterioration due to mishandling.

From this all too brief look at the renderer's connection it can be seen that in addition to producing goods worth some $1.5 billion annually, the invisible industry directly provides income for thousands of men and women, ranging from truckers, seamen and railroaders to surveyors, laboratory technicians and brokers and indirectly affects the income of thousands of others.

7 THE ASSOCIATION

Quietly, invisibly for nearly a century prior to 1930 the rendering industry in this country grew and prospered. Occasionally, there was a period of economic difficulty, like the depression of 1923, but generally favorable supply and demand conditions prevailed and prices for tallow and meat/bone meal were reasonably good.

It was perhaps due to this extended period of favorable business conditions that the industry did little or nothing to provide for any sustained period of hard times. This apparent complacency is underlined in an excerpt from a report prepared during 1927-28 and published a year later by the Food Research Institute of Stanford University. The volume, entitled "Inedible Animal Fats in the United States," was authored by L. B. Zapoleon. In it, Zapoleon wrote:

"The rendering industry does not seem to have developed even the ordinary type of trade association, though the time seems overripe for such a one. The industry seems admirably suited to the development of cooperative or joint marketing organizations. It consists of many scattered small units and a few large ones. In a given section of the country a group of the small units which do not compete with one another for raw materials, because they are located in different towns, might form a mutual marketing company through which the output of the members could be sold. Thus the products of a number of small plants could be assembled, uniformly graded and standardized, blended, stored or warehoused, to meet the requirements of the market better than the individual small concern is able to do. The group could sell more effectively. Instead of selling to brokers and to compounders of mixed feed and fertilizer, it could prepare such compounds and market them direct. There would seem to be no legal obstacle to such cooperative marketing, provided the group is not sufficiently large to control national prices and eliminate competition. The plan seems feasible because of the necessarily scattered location of plants. If one such group were successful, similar groups would be organized in other regions.

"Similar groupings are already organized or in process of organization in other lines. Groups of wholesale grocers, for example, are being formed, consisting of individual concerns that do not compete with one another because they are located in different cities. This is one of the defensive moves being made by wholesale grocers against the incursions of the chain retail grocery stores. Groups of butchers are also organizing for the disposition of offals. A group of this kind is the Chicago Butchers' Rendering Company, which seems to have been quite successful. Similar organizations are in existence in New York and Milwaukee.

"At any rate, with the meat-packing and soap industries organized as they are at present, it seems desirable that the rendering industry should become at least trade conscious, and the first step would be the organiza-

tion of a trade association."

At the time the Stanford study was being written, Zapoleon had no indication that the 1929 economic crisis was about to plunge U.S. business and industry into chaos. While he was suggesting the advisability of a trade association representing the rendering industry, he was unaware that, in fact, an association was almost an absolute necessity.

In times of adversity man tends to join hands on the general thesis that "in unity there is strength." The economic climate accompanying the severe depression of late 1929 and the following three years, together with a high degree of interchangeability which technological advances had developed among animal and vegetable oils, brought to the rendering industry a time of severe adversity. Suffice it to say that by 1932, the price of tallow had plunged to two cents a pound. It was during this period that renderers, traditionally strongly competitive and fiercely secretive about their businesses, reluctantly began to consider the necessity of group action. By 1931, in the East, in the Midwest and in the West, groups of renderers began informal discussions aimed at finding ways to stabilize their markets, improve their economic situation and develop a series of standards by which product quality and, therefore, price could be measured.

In the West, renderers in the San Francisco Bay area got together with those in California's northern San Joaquin Valley and the North Central coast area in 1932. Records of that meeting are virtually non-existent but one gentleman who was in attendance remembers it well.

William H. "Bill" Floyd, president of a California commodity brokerage bearing his name, is 87 years young. He is not a renderer but has been intimately connected with the industry in the West as a broker since starting his career with S. L. Jones & Co., in San Francisco. Working in the company's fats and oils department, Bill Floyd came into close contact with those who produced both vegetable and animal fats. Shortly after the Armistice brought the so-called "big war" to an end, Floyd went into business for himself and developed an even closer relationship with Walter Stein, president of Willits & Co., a major tallow exporter. Floyd ultimately got as close to rendering as anyone could without, as he puts it, "actually pitching offal with a shovel."

In those days, renderers in the northern part of California had little in common with those operating in the Los Angeles area 400 miles to the south. In fact, they tended to look down their noses somewhat at their southern cousins. With the fiercely competitive environment in those early days, it is easy to understand how there was even a little antagonism. Floyd's involvement with the San Francisco group and his role when, in 1923, he set up business in Los Angeles, serves to emphasize this apparent lack of rapport.

"When I went south," Floyd recalls, "the San Francisco renderers paid me to represent them in the southern part of the state. The industry down there was growing and was developing into stiffer competition. Peterson Manufacturing and California Rendering were big and the packers — Cudahay, Wilson, Swift, Standard and Hauser — operated their own plants. Also there were lots of 'grease peddlers.' I sort of kept track of things going on in the Los Angeles area and made regular reports up north."

The 1929 stock market crash and subsequent economic problems

changed all that. By 1932, it became apparent that renderers, North as well as South, would have to form some sort of association to deal with problems common to all.

"You know, today," Floyd explains, "we have members who are renderers and associate members who represent brokers, equipment and service companies who deal with renderers. Way back then there was no difference. We all were involved in the animal fats and oils trade so when it was decided to hold a meeting with a view to creating some sort of trade group or association, we all were included."

"I remember that first meeting was on the second floor above a restaurant on O'Farrell Street near Market in San Francisco. The restaurant served dinner upstairs to us after the meeting. We were pretty unsophisticated in those days. No cocktail parties—the liquor and beer was set up at one end of the room and when you wanted a belt you just went and got one. Rendering was a dirty, stinking business and most of the men who founded and built the various companies were plain, hardworking, tough-talking guys who as often as not swung a shovel alongside their workers loading offal into the cooker. There sure as hell wasn't a sissy among them. Most of them were self-made men with damned good business heads.

"That first meeting was a pretty harmonious one especially when you consider the kind of men they were and the fact that they ran family businesses and, where business was concerned, didn't express an awful lot of trust in one another. They expressed varying ideas about where the industry was going and where it might lead. One thing surfaced almost immediately—not one of them was entirely sure exactly where he was going or how to get there. A single fact became apparent to each of them. They stood a better chance of achieving their individual goals if they got together and found common solutions to common problems."

The embryonic Pacific Coast Renderers Association met on that second floor above the restaurant for two years running and as Floyd recalls it "got well organized pretty darned fast." By the second and third year they were "really on their way." Within the next five years they pretty well established a "sellers" market for themselves, Floyd recalls.

About the same time, perhaps a year earlier, New York renderers under the leadership of M. F. Pick had founded their own trade group—the Eastern Melters Association—and in the Midwest, Henry J. Shulte, Sr., of the Detroit Rendering Co., was spearheading a movement which would by 1933 give birth to the Association of American Producers of Domestic Inedible Fats, the forerunner of today's National Renderers Association.

Shulte first invited seven renderers from the Detroit-Cleveland-Columbus area to meet with him at the Detroit-Leland Hotel in June 1931. The gathering was informal and no records were kept. Among those attending were Don Pfeiffer of the Akron Soap Co., John Hamel of the Valley Chemical Co., Carl Baas of the Columbus Rendering Co., and Waldo Behr of the Wayne Soap Co. Also attending were representatives of the Fostoria By-Products Co., the Cuyahoga Soap Co., and Stadler Products Co.

Word of this meeting made the rounds of the industry slowly but in September A. L. Buxton of the Kentucky Chemical Co., heard of it. Buxton also had long been concerned with the need for an association and immediately contacted Shulte indicating his desire to actively support any

such movement. Buxton also stepped up his advocacy of such an organization among the Cincinnati renderers.

R. E. Morse of Boston joined with Pick of the Eastern Melters Association meeting with Shulte's group in 1932 and again later that year in Chicago. It took the better part of a year to work out the details of a formal organization and prepare a set of bylaws. During this organizational period, the elder Shulte acted as chairman of the informal committee with R. C. Buck of the Darling Co., as secretary and Henry Shulte, Jr., as secretary. Morse headed a subcommittee charged with setting up the national organization, soliciting renderer support and assisting in the formation of local or regional associations. Finally in December 1933, the Association of American producers of Domestic Inedible Fats came into being. Now the real work began.

Those were the days of the National Recovery Act—the NRA or so-called "Blue Eagle" law with its complex set if highly restrictive industry codes and regulations. Thus the first order of business was to prepare an industry code that would satisfy the National Recovery Administration. The assistance of George Link, a New York attorney, was enlisted and over a period of months a proposed code in one form after another was assembled and presented to the NRA administrator in Washington. None was found to be acceptable but, fortunately, the requirement for such a code was eliminated when the law calling for it was held unconstitutional. The newly founded association and the rendering industry did, however, gain considerable insight in a very short time into the intricate ways of dealing with the Federal government.

Another immediate task faced by the infant association was the problem of "two cent tallow." A. M. Loomis was retained as Washington representative for the association and an intensive study was initiated into the structure of the fats and oils industry as it then existed. A number of hard facts soon presented themselves. One — the United States basically was an "import" nation when it came to fats and two — the high interchangeability of fats made possible by technological developments made it possible for the major consuming industries to use the cheapest oil available which at that time turned out to be coconut oil at two cents a pound — thus this imported commodity dominated the price structure.

Ultimately, the renderers joined with other interested groups throwing their weight behind a move to obtain tariff protection. Their efforts were rewarded when a so-called excise tax on fats and oils was included in the Revenue Bill of 1934.

In the original law of 1934, these taxes fell into two separate categories—namely, excise or import taxes and processing taxes. The excise or import taxes were levied on a group of fats and oils and oil-bearing materials which were similar to the same class of items produced in this country and included taxes on such commodities as inedible tallow, fish oils, whale oil and a number of other oil-bearing materials which could be produced in this country.

On the other hand, the class of items subjected under the 1934 law to the so-called processing taxes were limited to certain oils which could not be produced in this country; among the important commodities in this category were coconut oil, palm oil and palm kernel oil. After several years of operation of the fats and oils tax law, various evasions and ambiguities in the law had developed with the result that in 1936 a

strengthening amendment was passed by Congress as part of the Revenue Act of 1936.

These fats and oils taxes have been the subject of attacks from time to time by domestic consuming interests who use such materials in producing finished products and who, therefore, have an interest in obtaining these materials as cheaply as possible. These attacks have had varying degrees of success over a period of years but perhaps the most damaging overall challenge has come in the 50 percent downward modification of many of these taxes, accomplished under the provisions of the Reciprocal Trade Agreement program. The cornerstone of this program ironically also is a provision of a law passed by Congress in 1934 in the form of an amendment to the Tariff Act and commonly referred to as the Reciprocal Trade Agreements Act. The original purpose of this act was claimed at the time to be for the purpose of eliminating barriers to international trade so that world commerce could be stimulated, thereby improving business and economic conditions throughout the world.

As a result of the operation of this program, many of the excise taxes on imported fats and oils have been successfully decreased to a point where they now are insignificant. It appears that federal lawyers have concluded that those fats and oils taxes which were in the category of internal processing taxes could not be subjected to the downward modifications permitted in the Reciprocal Trade Agreements Act and up to a short time ago domestic fats and oils producers still were assured of continued protection under this section of the law. However, in recent sessions of Congress several proposals have been made by the government to reclassify these taxes, allegedly in the interest of customs simplification and it may be that the eventual result will be that they will be successfully challenged in one way or another. As a matter of fact, the proposed reclassification already has brought demands from consumers of these oils that the taxes be eliminated altogether. At present it appears that this matter will be the subject of further considerations in Congress.

There is little doubt today that the activities of the association in pressing for the initial fats and oils excise and processing tax law in 1934 was one of its major contributions to the rendering industry.

By this time the association had established a permanent office for Loomis in Washington and the following year hired a full-time paid secretary-treasurer in the person of B. F. Wise. This action is looked upon today as probably marking the emergence of this industry group into a full fledged trade association. Loomis, by the way, continued to serve the association until his death in 1940, while Wise remained at his post until 1956 when the association moved its headquarters from Washington to Chicago. At that time James C. Fox succeeded Wise as secretary-treasurer and the office of executive director was created with John J. Hamel, Jr., selected to fill this post.

The name of the association was changed to the National Renderers Association in 1942, at a time when the rendering industry was wrestling with the problems of securing price ceilings under the provisions of the wartime Office of Price Administration regulations. As World War II wound down, the NRA addressed itself to new challenges which began to loom on the horizon. Not the least of these was a situation in which production, stimulated by technologies developed to meet wartime necessity, threatened to outstrip consumption. The industry needed ag-

gressive action to develop new markets for its animal fats and oils. Little did it know then just how severe this problem would become in a few years when synthetic detergents would literally wipe out the laundry powder market.

In 1949 the association finally prevailed on the government, the USDA to be specific, to actively enter into a program to develop new uses for what now threatened to become one of the nation's "surplus" commodities. That year $225,000 was appropriated to the USDA for use by its Eastern Regional Laboratory to conduct research and development. This work has been of major importance to the rendering industry during the ensuing years.

NRA began its own work in 1950 in cooperation with the American Meat Institute Foundation to determine uses for meat scrap and tankage. This developed by 1952 into a full blown program to stimulate the use of fats in feed. In 1954 the NRA began a program of research and sales promotion on the use of animal proteins in livestock feed. Also, during this period, the association carried on aggressive programs to increase the nation's exports of inedible fats and oils, with the result that by 1956 our exports amounted to nearly 50 percent of our total production. In that year, also, the NRA entered into a cooperative agreement with the USDA's Foreign Agriculture Service whereby an active program to market U.S. tallow in the Far East was launched.

Over the years NRA has enjoyed steady growth and today ranks in the top half of one percent of the more than 19,000 trade associations in the U.S., a tribute both to the rendering industry and to the men selected to lead the association since its inception.

Like all similar organizations, the NRA was established to achieve a broad area of general objectives.These were called out in the association bylaws which state:

"This association is organized for the purpose of furthering the common interests of its members and of the rendering industry as a whole. It shall accomplish this purpose by causing research programs to be undertaken, by evaluating and disseminating technological advances made thereby, by representing members of the industry before various governmental agencies, and by doing all other things necessary to accomplish said purpose . . ."

NRA's current executive director, Dean Specht, points out, however, that it isn't the lofty statement of purpose that makes a trade assocation successful (and therefore enhances the position of that industry or business), but "the hard core programs instituted to achieve not only the stated objectives, but those which achieve the versatility and organizational flexibility to meet the new challenges which appear on an almost day-to-day basis."

"It is perhaps in this latter area wherein NRA's strength really lies," he adds.

Specht offers a case in point—the situation arising when the then new Occupational Safety and Health Administration established its original priority list of target industries. One of those industries was meat packing and, as often is the case in the halls of government, the new agency was pushing ahead without the benefit of thoroughly understanding the industries it must regulate. This lack of understanding lead OSHA to lump the rendering industry in with meat packing, an industry which had long

been confronted with severe safety problems.

On the surface this does not appear to be a serious situation. Why not simply inform OSHA that renderers have a good safety record and petition for an administrative separation of the two industries? Easier said than done, especially if the verbiage of the implementing regulations and directives gets locked in all along the line.

"One of the most important functions of a trade association," Specht explains, "is maintaining a finger on the pulse of government. You have to know what is coming and as far in advance as possible. In the case of the OSHA targets, we were able to identify the problem early and put our finger on the cause. The appropriate people at OSHA were briefed and based on a new understanding of the relationship between meat packing and rendering, our industry was quickly eliminated from the list of high risk target industries."

NRA more recently found itself in the midst of a similar effort in connection with the 1970's energy crisis. It was urgent that the action agencies fully understood the role of the renderer in the food chain and in the ecology loop, and also that fuel allocation authorities at state level realized the importance of rendering as an element of health and sanitation and as a source of important livestock and poultry feed supplements. In a dramatic real-time situation NRA carried on a crash educational program at the top levels of government and concurrently disseminated to its members as fast as possible, new information on governmental posture when it became available. As a complementary activity, the association developed and distributed a practicable plan for energy conservation for use at the plant level.

"What a program like this means," Specht emphasizes, "is that we must bt able to cover a lot of bases quickly and almost simultaneously."

By 1961 the association began to function on an international basis. Research, domestic and overseas marketing continued to expand and a fulltime executive director joined the association. In 1962 a European office was opened and in 1964 an office was opened in the Far East. The worldwide staff of NRA now numbers more than 35.

An important step taken in the early sixties was establishment of a research foundation. Even though NRA was doing extensive research in many areas, leaders in the association felt it would be more effective with a separate foundation and a technical research director supervising the projects. In 1963, the Fats and Proteins Research Foundation (FPRF) was created and all records, rights to projects and research funds were transferred to the foundation. Its offices are near the NRA offices in Des Plaines, Illinois.

In 1965 the Poultry By-Products Association was merged into the NRA. Each association had been promoting feather meal and other poultry by-products. By joining together it was possible to provide a stronger marketing promotion effort for poultry by-products renderers.

The importance of NRA today and in the future is even greater than in the fifties when the largest market for renderer products was drying up and crash research programs were required to develop new markets. The cost-price squeeze common to many industries is a major factor in the rendering business. Better production methods and merchandising efforts are needed to bring profits in line. International trade must be expanded further and new applications for fat and protein will have to be developed.

Increased regulation by government continues to require more effort and planned action.

In 1933 the purposes of the NRA defined in the bylaws were those the board could see as purposes at that point—a strong research program reporting its results to the membership and some governmental representation. These purposes were amended only slightly in 1957 when the NRA was incorporated (in the state of Illinois) as a nonprofit association. It was this action, by the way, that qualified NRA as a "501C6 trade organization" and gave it tax exempt status under International Revenue Service regulations.

"Today," Specht explains, "there are three other very important purposes that have not been specifically called out in NRA's bylaws but which are very much a part of the association's objectives.

"The one which takes more of our time but certainly not most of our budget, is overseas market development. It takes more manpower, when you take into consideration our overseas staff, than any other part of our association activity. We have more employees in it. However, we use mostly funds provided by the USDA Foreign Agriculture Service to which NRA adds cash goods and services. Ours, by the way, is but one of a number of such contractual arrangements between the government and U.S. associations or industries wherein a team effort is put forth to increase foreign markets for American agricultural products.

"While foreign market development takes most of our time, it is the second of the current objectives that takes most of our money. That is still in basic research. Approximately $200,000 of our annual budget—renderer's dues—is passed on to the Fats and Proteins Research Foundation. This constitutes FPRF's single biggest source of income.

"The third purpose, I think, would have to be in this area of representation to government. We are not a lobbying organization. The board of directors has not sponsored that, has not fallen in line behind it, has not urged us to do it and, in fact, that is not our mission. As a small manufacturer industry we do not have the clout to go into the halls of Congress and organize the grass roots support of a great number of senators and representatives that is needed to influence basic legislation. We can do some maneuvering and it's probably time that we got our feet wet in doing that. Recently, we organized a Legislative Action Committee to work generally on legislation, agencies and the kind of regulations that come out of this area. In other words, a legislative liaison kind of service—a go-between for the many members of our industry that do have some impact in Washington and the Washington scene."

Assisting Specht in the overall management of the association's business are Executive Assistant Robert Werner and Administrative Asistant Pat Nygaard and five staff specialists: Dr. Conwell Johnson, director of Product Development; William Prokop, director of Engineering Services; Jack Crouse, director of Market Development, and J. David Anderson and J. Stewart Cox who head the Far East and European offices, respectively.

NRA's national headquarters is situated in a comfortable, but not elaborate, suite of offices in a modern business complex only three minutes drive from Chicago's huge O'Hare International Airport. Offices of the FPRF and its director, Dr. Werner Boehm, are only a quarter mile distant.

"Con" Johnson, as he is known throughout the industry, speaks quietly and authoritatively about his function for NRA. Specifically, he emphasizes the importance of bringing the renderers "some expertise about the feed industry" and as a trained animal nutritionist with long experience in livestock and poultry feed, he is just the man to provide it.

"Basically," Johnson points out, "the feed industry today is our single biggest customer and if we aren't familiar with its problems we are going to miss the mark when it comes to servicing that market. Therefore it is my objective to share with the rendering industry my years of experience with the feed industry."

Johnson sets the number of feed companies in the U.S. at somewhere in excess of 5,000 and he underlines the importance of getting the renderer's message about the nutritional value of feed fat, meat/bone meal and feathermeal to the feed industry through the medium of symposia, seminars, conferences and workshops. Obviously, he says, it would be impossible to visit all the feed companies, even all the large ones, on a regular basis, hence the importance of NRA representation on the seminar circuit.

One of NRA's principal efforts in this area is the annual "renderer's symposium" held in connection with the Georgia Nutrition Conference which is attended by upwards of 125 of the nation's top animal nutritionists each year. Reaching these experts, Johnson sees as a means of "multiplying myself" to spread the work.

"There is a healthy interface and a good exchange of information between these experts, most of them in the academic and research world, and those individuals faced with the practical problems of running the feed mill," according to Johnson who also emphasizes that "although the Georgia conference is one of the main gathering points for nutritionists there are more than 25 important meetings around the country each year."

In Europe and the Far East NRA is the sponsor of similar conferences as appropriate and is earning the reputation as a leader in those areas for the dissemination of new information and current research in animal nutrition.

Another of the doctor's primary responsibilities is working in the field of product improvement—keeping abreast of the newest technology and making it available to the rendering industry through the NRA Product Development Committee. He is the headquarters staff liaison to the committee and as such takes an active part in its work. Johnson also acts as an advisor to the FPRF director in his areas of special expertise.

Like other members of the NRA staff, the doctor also has to be a "fire fighter." Whenever the rumor mill comes up with a new, unsubstantiated theory which affects the acceptance of rendered products in the animal feed area, he must quickly investigate, gather scientific information where it is available (or initiate action in the appropriate quarters to have such information developed), assess the accuracy or inaccuracy of the new theory and, when appropriate, get out information to refute it. Such was the case when a rumor swept the feed industry that the biological availability of amino acids in feathermeal left much to be desired.

"The chemical analysis of a feed ingredient shows how much of a nutrient is present but reveals nothing about whether that nutrient is biologically available, that is, available for use by the animal for

maintenance, growth and production, Johnson explains.

Since this is a relatively new scientific field, Johnson immediately made a search for recent research on the subject. As it turned out dramatic new information had been developed but had not as yet been widely disseminated. It revealed, for instance, that the biological availability of lysine (one of the most important amino acids) in feathermeal was as good and in some instances better than in competitive ingredients such as soybean meal and full-fat ground and cooked soybeans. In the case of 17 amino acids, each of which has a role in growth, the research confirmed the excellent biological availability of these acids in all the renderer's products—meat/bone meal and poultry by-product meal as well as feathermeal. Quick work on the part of NRA set this rumor to rest before serious harm could be done.

The feed industry rumor mill isn't too different from that operating in virtually every segment of business and industry. Reports like this one often get started when a dealer is out of a certain product. In order to persuade his customer to accept one which is in good supply he will knock the one that is temporarily unavailable. Like all such instances, these quickly bloom into "authoritative reports" and begin to spread like wildfire.

"When they do," Johnson says, "it is our job to pick up the pieces, prove that the report was false and get it out to the industry."

One of the major new challenges Johnson sees for the renderer is the emerging requirement to provide a tailored product. Customers for both feed fat and high protein meals are beginning to look for products with specific content levels of various nutrients. In the not too distant future he expects that a customer will demand a "guaranteed analysis covering most major nutrients." This, Johnson says, is going to necessitate that each renderer who wants a portion of this market become a blender or that groups of small renderers get together and support a common blending facility under some sort of joint marketing arrangement. Either way it is sure to increase the renderer's cost of doing business.

What began for Bill Prokop as a straight forward task of advising the member renderers on methods of plant operations with emphasis on controlling the traditional odor problem, has developed into a many-tentacled monster with the advent of national concern for water purity, industrial safety, employee health and energy conservation. An increasing amount of his time is being consumed just keeping up-to-date with new governmental directives and regulations, translating these into understandable guidance for the industry and disseminating information to the renderer while it still has some value.

"It would be easier if I had five heads and 10 pairs of hands," Prokop jokes, adding that "it helps to keep a sense of humor."

In addition to the plant engineering aspects of accomplishing air pollution, water pollution and energy conservation goals, and conforming to the regulations of the Occupational Safety and Health Administration (OSHA), Prokop today is the NRA action individual for interpreting and passing on to the field the latest directives and guidance on oil and gasoline allocations.

"Sometimes," he says, "I think I'll go blind just reading government regulations."

Becoming serious, he outlines his responsibilities this way:

"Basically I am concerned with anything that has to do with plant

operations, anything that would affect the plant being able to operate continuously, including problems from external forces. This can consist of a variety of problems such as those involving odor control and water pollution, employee health and safety, accident prevention and the sources of energy needed to operate the plant."

While Prokop admits that in recent years the question of air and water pollution appears to have received most emphasis, he personally feels that plant safety and accident prevention deserves equal attention.

"After all," he declares, "people are our most important resource. We must take all steps necessary to protect them from injury. And, obviously, there also are strong monetary reasons for having an aggressive in-plant safety program."

Prokop sees the overall safety record of the rendering industry as "very good" particularly with respect to serious injuries or deaths due to accidents. However, he is concerned with the relatively high incidence of less serious accidents, mostly involving falls due to the inherent lubricating quality of tallow.

"Just keeping the plant clean, taking care of spills quickly and thoroughly isn't enough," he warns, "we've got to do something about providing better footing. There has been a lot of research into ways to make flooring, stairs and walkways slip-proof and we are looking into them."

Another area of major concern to Prokop is fire prevention. He tells of three disastrous blazes during a single month in 1973 which completely destroyed the plants involved.

"We feel strongly that we must provide an effective fire prevention program along with the safety program," he said, pointing out that initial action in this area already has been accomplished with more to come.

Outlining the work that both the NRA and individual renderers have accomplished in recent years with regard to control of rendering odors, Prokop said:

"This is an area that still is wide open," he declared, "and one of the things that I am vitally concerned about and have been since I took over this job is the type of odor regulations that are being promulgated for our industry from the standpoint of whether or not they are of the nuisance type that is very broad and virtually impossible to administer, and even more important, what is the odor unit—how do you measure odor? You can only regulate plants and their emissions with regard to how reliable your measurement is.

"We took the bull by the horns several years ago and started a program to develop an odor sensory measurement system. This represents one of the big contributions of our industry to the whole area of odor control. Our leadership in this is recognized throughout the industry and in the government. It is a significant step toward developing a practical regulation based on practical odor tolerance levels because it gives us a practical way of measuring it."

Prokop is quick to point out that his use of the editorial "we" in discussing the accomplishments of his office embraces both the FPRF and NRA's Plant Operations Committee. One of his responsibilities is staff liaison with that committee.

NRA's third "expert in residence" is Jack Crouse whose attention must be directed to developing new markets and maintaining the existing ones

both at home and abroad. In practice, however, his primary mission is promoting the export sale of renderer's products and in this capacity he works closely with the NRA offices in Brussels and Tokyo. He also is responsible for the organization and design of the programs executed by NRA market development teams traveling abroad as well as the programming for customer teams traveling in this country. He finds himself in almost daily touch with the USDA's Foreign Agriculture Service in Washington since it is under contract to FAS and NRA conducts much of its foreign operations. Like his counterparts, Con Johnson and Bill Prokop, Crouse also is staff liaison to a key NRA committee—the International Marketing Committee.

In addition to Bob Werner's many duties as direct backup to the executive director, he also is staff liaison to the NRA Public Relations Committee, the Management Information Services Committee and, for all intents and purposes, functions very much in the manner of a corporate director of Public Relations on the headquarters staff. He oversees the development of films, slide presentations, brochures and informational material, acts as the editor of NRA monthly Newsletter distributed to the membership and also edits the NRA annual publication, "Spectrum."

NRA's annual budget is over $1.7 million with about $912,000 coming this year from member dues assessments, interest, publications and unspent funds. The remainder represents the proceeds from the contracts with the Foreign Agriculture Service. These latter funds go entirely to defray the costs of the foreign marketing programs established each year by agreement between NRA and FAS.

NRA members are assessed dues on the basis of a "unit" system, a unit defined as "a rate per $100,000 F.O.B. sales for the preceding calendar year of produced oil and protein products involved during that year." There also is a sliding scale whereby every member whose annual business is zero to $2,500,000 pays one unit per $100,000 in sales while those whose business is in excess of $50,000,000 would pay only two tenths of a unit per $100,000 in sales at the upper end of the scale. Currently a unit is valued at $325. The budget formulation schedule works this way—a member receives his dues declaration form in February; returns it by April; in June a tentative budget is established based on the units declared; in November this budget is finalized for the next fiscal year and a unit value is established based on the member's declaration; and, also in November, the member is billed for his assessment.

Now in its fifth decade of service to the rendering industry, the NRA continues to interface with an ever increasing number of regulatory agencies, works to find new uses for its products and develop new markets, informs the public in areas vital to the industry and provides a means for the interchange of technical information on plant operations and product improvement.

The USDA's Foreign Agriculture Service makes no bones about how it feels when it comes to the NRA/FAS joint foreign marketing programs.

The contract with the NRA is one of the best of the more than 50 managed by FAS. With the NRA we get the most production out of what money is available, an FAS official explains.

While foreign marketing efforts formerly were primarily necessary for the purpose of disposing of surplus agricultural products—and this was important to the economy—they have become even more important today as the U.S. faces a critical balance of payments situation. In fact, it has

been agricultural products that have bailed the U.S. out of its balance-of-payments hold and stemmed the tide of outgoing dollars.

As the nation continues to lose ground in many of the areas of manufactured goods where we have reluctantly given up world leadership and where domestic demand for foreign products continues to climb, our agricultural exports play an even more important role. And, as this occurs, the importance of foreign market development efforts such as that put forth by the NRA becomes increasingly significant.

Tallow is a most important agricultural commodity, not only in dollars, but also in market penetration. Today it is being exported to approximately 60 foreign markets. It also is unique in that the U.S. is the "big frog in the pond"—perhaps 80 percent of the world's imports come from this country.

NRA's contractual efforts in behalf of FAS began in July 1956 in the Far East and in April 1957 in Europe. In the language of contracts—there are separate agreements for the European and Far Eastern activities—the NRA is the "cooperator" while the FAS is the "administrator." While the responsibility of the administrator is primarily to insure that the U.S. taxpayer gets his dollar's worth, the cooperator is responsible for the overall execution of a comprehensive marketing plan developed each year by NRA and approved for implementation by FAS.

Broadly stated, these are the NRA contractual activities:

- conduct market studies for the purpose of locating obstacles to imports of U.S. inedible animal tallow, grease and animal protein to project countries; obtain information related to the use of inedible tallow and grease in soap manufacturing and the use of fats and animal proteins in livestock and poultry rations in project countries; and collect data on trade restrictions, prices and other economic information pertinent to the marketing of U.S. rendered products.
- assist foreign buyers, importers, feed manufacturers and livestock producers in learning the advantages of adding tallow and greases to feeds; assist livestock and poultry producers by providing nutritional information; advise soap manufacturers and related industries in the use of U.S. rendered products.
- arrange for visits to foreign trade teams, government officials, industry representatives and technicians to the U.S. for the purpose of furthering the sale of U.S. rendered products abroad.
- arrange for the translation, printing and distribution of informational literature to the project countries.
- work to establish joint promotional activities in the project nations.
- exhibit U.S. rendered products at trade fairs and other appropriate events and provide information on their use.
- arrange for and coordinate the travel of representatives of the U.S. rendering industry within the project countries.

The contractual obligations of the NRA alone are a big bite to chew, let alone the specifics of the detailed marketing plan for each area.

The FAS/NRA relationship is unique in that a major portion of the work is accomplished by NRA members—members of the board of directors and appointed committeemen—who devote an immense amount of personal time and effort. They conduct their own hard core program with the support and assistance of NRA's foreign employees. In the case of

most other contractors, this work is done almost completely by paid staff. This is one of the elements which contributes greatly to the outstanding performance of NRA.

One of the most important aspects is personal representation by NRA members and the senior staff members of the association's Far East and European offices. A list of their eastern ports of call in any given year reads like a travelogue—Osaka, Kobe, Himeji, Fukuoka, Chiba, Hokkaido, Taipei, Keelung, Laohsuing, Taichung, Seoul, Pusan, Taegu, Manila, Hong Kong, Macao, Luala Lumpur, Djakarta, Gogor, Bandung, Penang, Medan, Semerang, Malacca and Singapore. While in Europe and the Near East they visited Italy, Spain, Algeria, Bangladesh, Cyprus, Federal Germany, France, Greece, India, Iran, Ireland, Israel, Lebanon, Luxemborg, Morocco, the Netherlands, Pakistan, Portugal, South Africa, Switzerland, Turkey, Egypt and the United Kingdom.

In addition, the European office visits provide information to and conducted educational workshops in a number of countries where trade in rendered products is growing but where it does not as yet warrant a continuous level of activity. These include Yugoslavia, Poland, the U.S.S.R., Austria, Denmark, the West African States, Argentina, Brazil, Bolivia, Chile, Ecuador, Mexico, Peru and Venezuela.

The office's newest tool is the use of linear programming for feed formulation, first successfully used in 1973 for technical servicing. Because of rapid price changes and frequent substitution of ingredients, feed manufacturers were interested in obtaining from us formulating help, particularly for the substitution of meat/bone meal instead of fishmeal.

An important activity for both of NRA's foreign offices is the regular and timely distribution of pertinent scientific, technical and commercial information throughout the customer community. In Europe, for instance, this calls for selecting and first translating the information into six different languages, then distributing it to a list of more than 8,000 recipients in 82 countries. Motivating foreign customers, traders and technical people to visit the U.S. always had been a prime function of the Far East Office.

Where it is not practicable for such teams to visit the U.S., groups from other Asian market nations are brought to Japan where they visit facilities employing advanced technology and methods similar to those being used here. For instance, a team of fat refiners visits major Japanese refineries to learn advanced production technology. Also, a Korean feed manufacturer's team and a Taiwan technician team visit sites in Japan where feed fat is being used in livestock rations and where they can observe livestock feeding technology more advanced than their own.

Another major area of activity for the Far East NRA office is the sponsorship of educational seminars and symposia. For instance, NRA teamed a series of seminars for technicians from feed mills, national and prefectural laboratory researchers, extension servicemen and industrialized poultry operators. Lecturers, each of whom devoted an entire day to his presentation and subsequent discussion, included men like John E. Streetmen, a former vice president of Allied Mills, Inc., Dr. E. Paul Taigaides of Ohio State University and Dr. Jerry L. Sell of North Dakota State University. The seminar was the first addressing the fat-in-feed-for-poultry topic in Japan and served to correct a general misunderstanding

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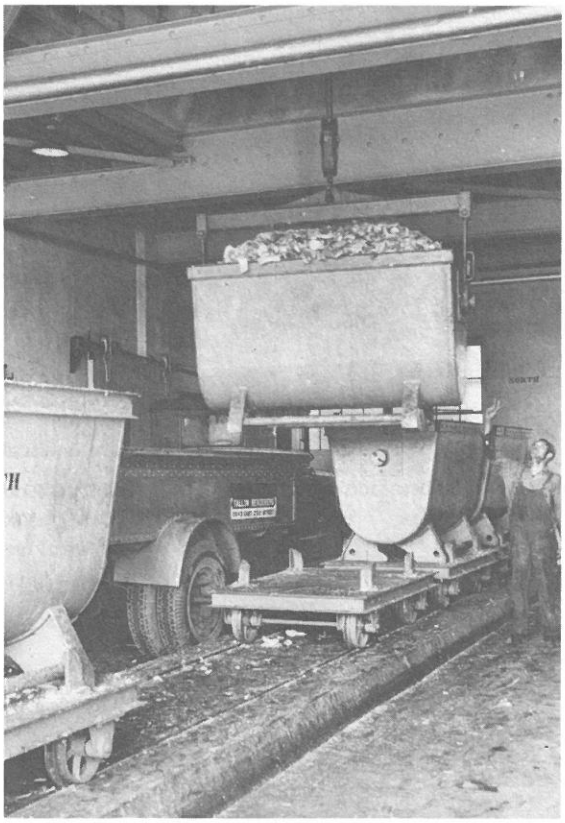
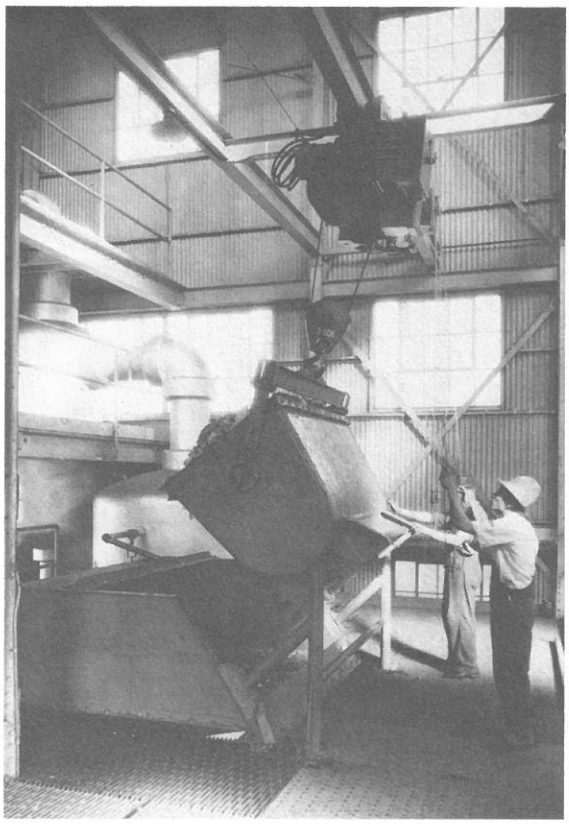
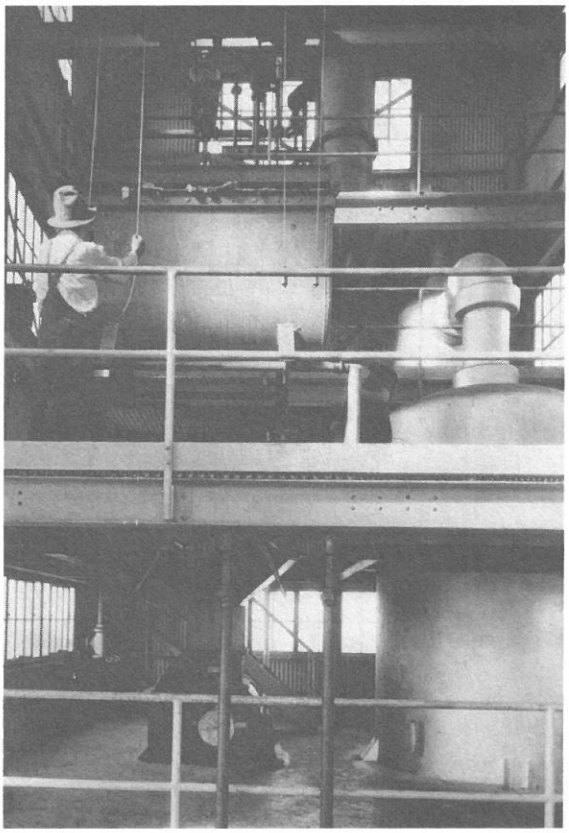
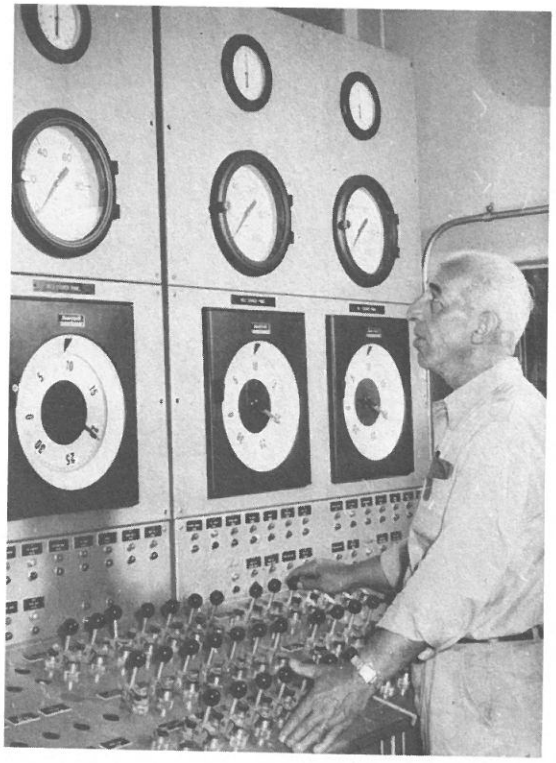






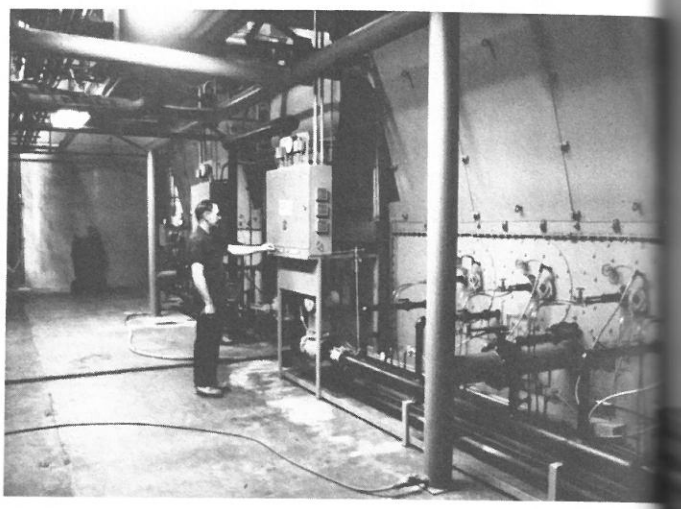
Just as the open melting kettle gave way to the pressure vessel, so did other technology find its way into the rendering industry. Renderers began to find ways to take some of the backbreaking labor out of the industry (but not all of it). In this unique application of mechanization in 1933, the bones and meat scraps still had to be shoveled by hand from the route truck to these containers. The containers, however, rested on wheeled carts that ran on tracks. When a container was filled, it was rolled into the cooker room where it was hoisted to the third level and dumped into a hopper feeding the grinder. From the grinder the raw material went directly into the batch cooker.



Soon automation was introduced. This operator could control a whole series of batch cookers from his panel.

Automation also took some of the work out of unloading the route trucks. Here, a hydraulic lift tipped the truck up dumping its load directly into the raw material bin. A screw conveyor then moved the material into the plant.

Modern render insure that pro by the custome



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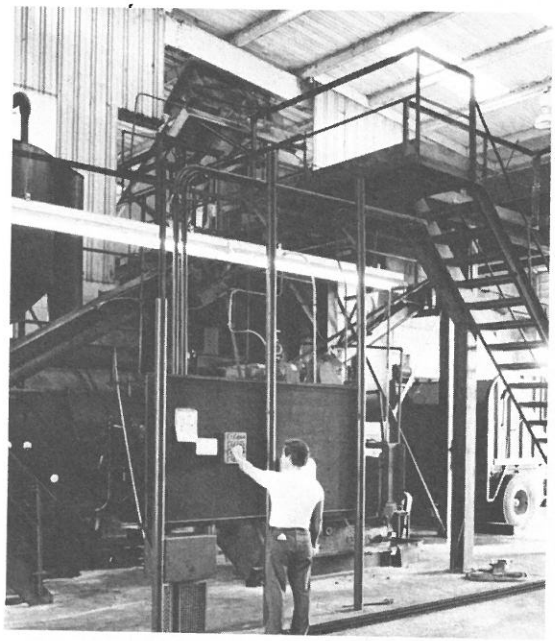
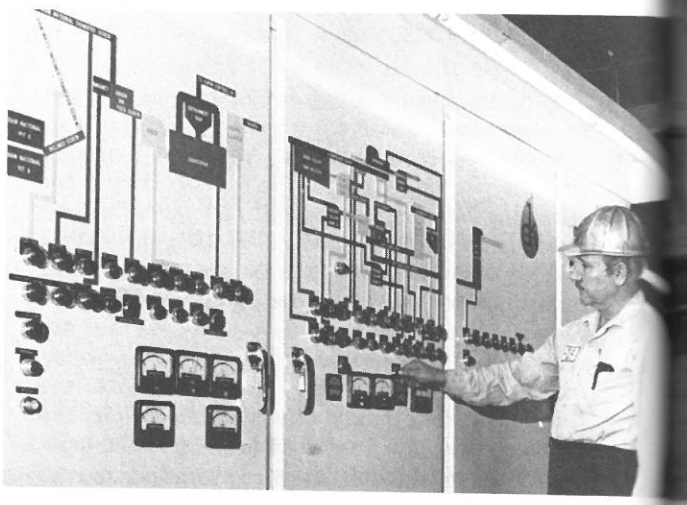
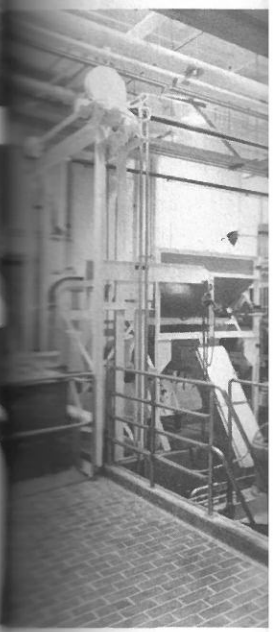


The modern continuous, dry rendering plant is completely automated. From the receiving bin the material moves through the plant — grinding, cooking, pressing, filtering, crax grinding and drying — without the need for physical handling. The entire process can be monitored and controlled electronically.





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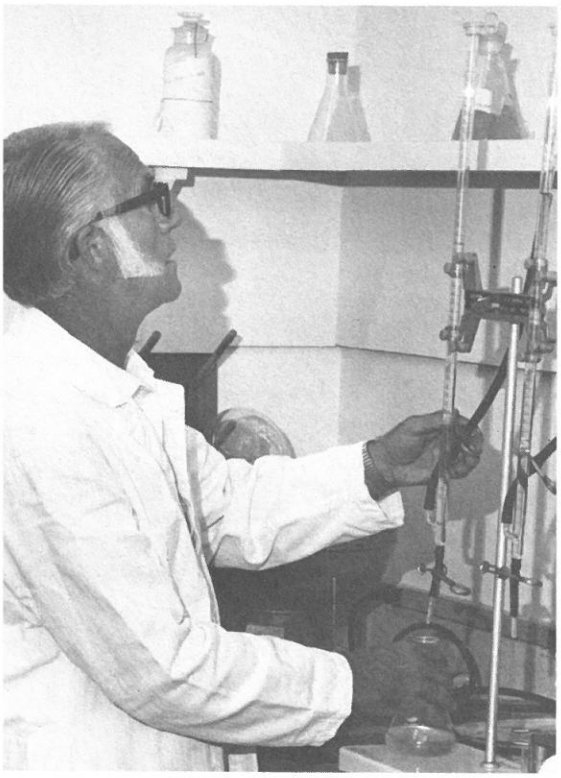
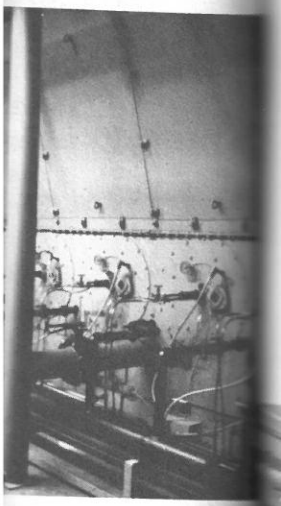
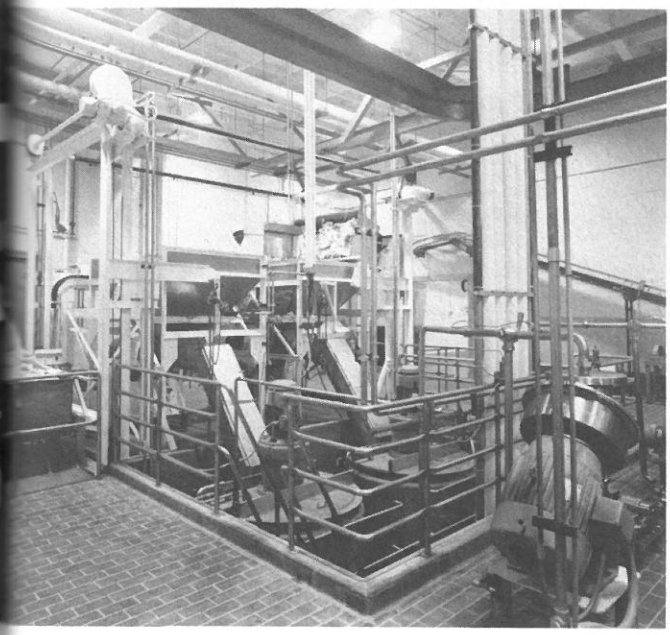
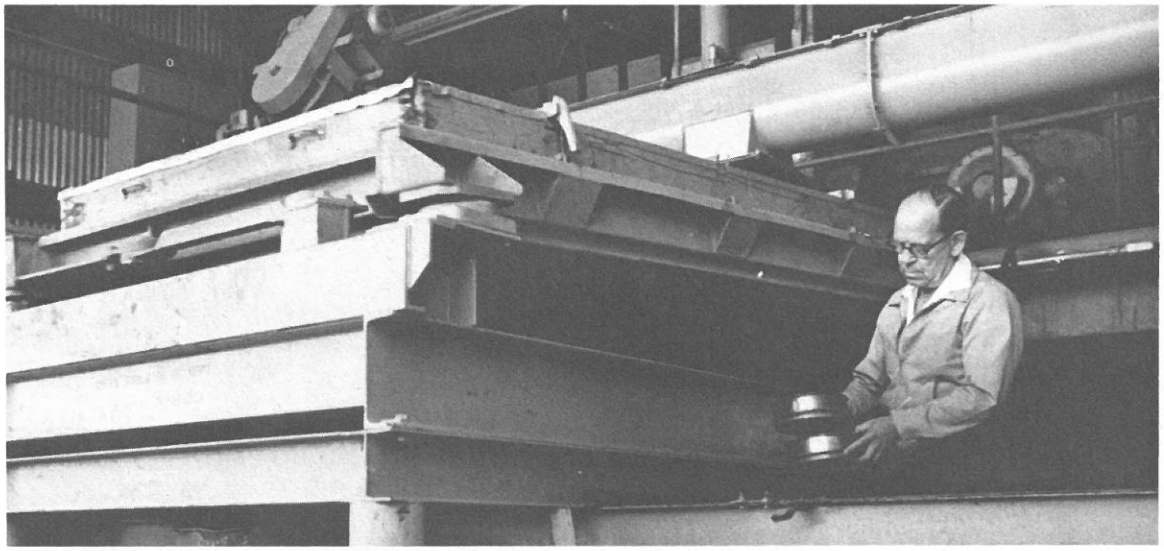


Modern renderers must maintain sophisticated in-house laboratories or employ independent laboratories to insure that product quality is maintained and to determine that their product meets specifications set forth by the customer.



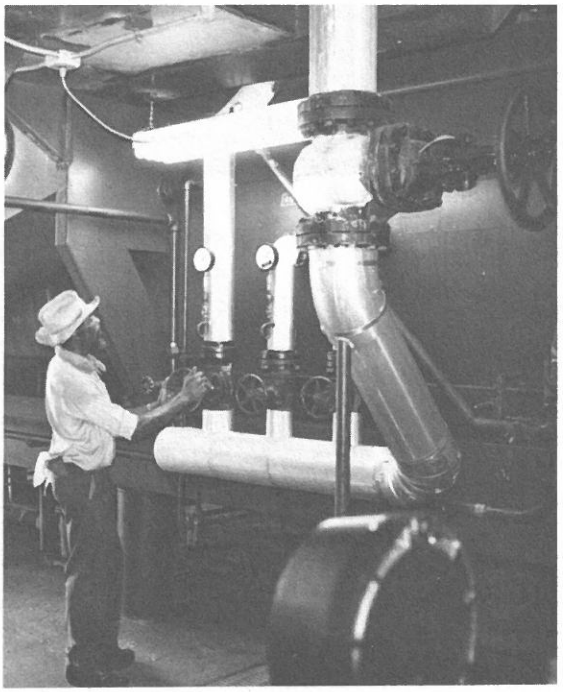
Edible rendering facilities are maintained in what approaches "hospital cleanliness." Operations are carried on under the constant scrutiny of U. S. Department of Agriculture inspectors.





Meat/bone meal is checked regularly to insure fineness of grind and the absence of foreign matter.

With all the automation, there still are jobs around the plant that require old-fashioned hands-on attention — cleaning the filter screens, maintaining the trucks, checking the boiler.



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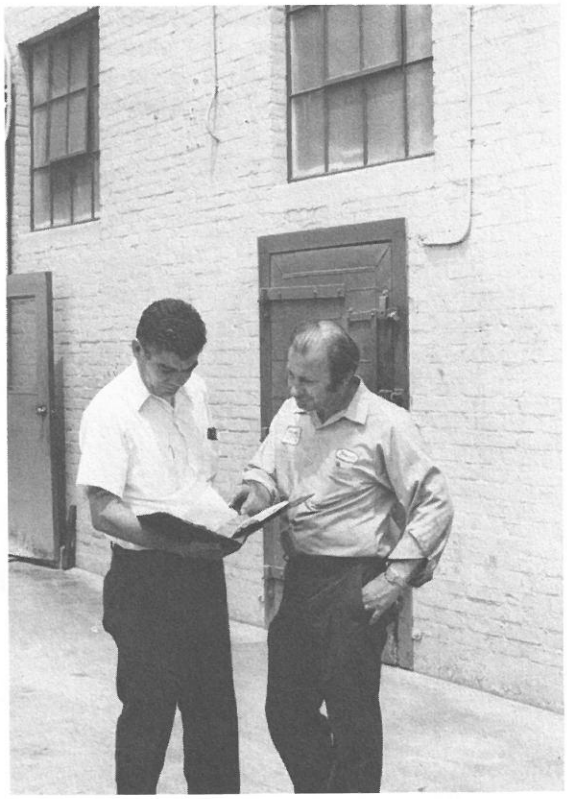
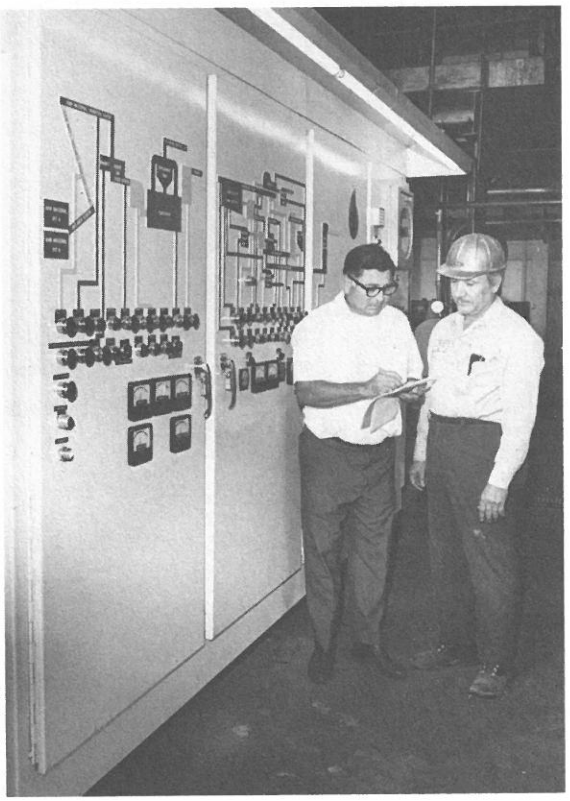
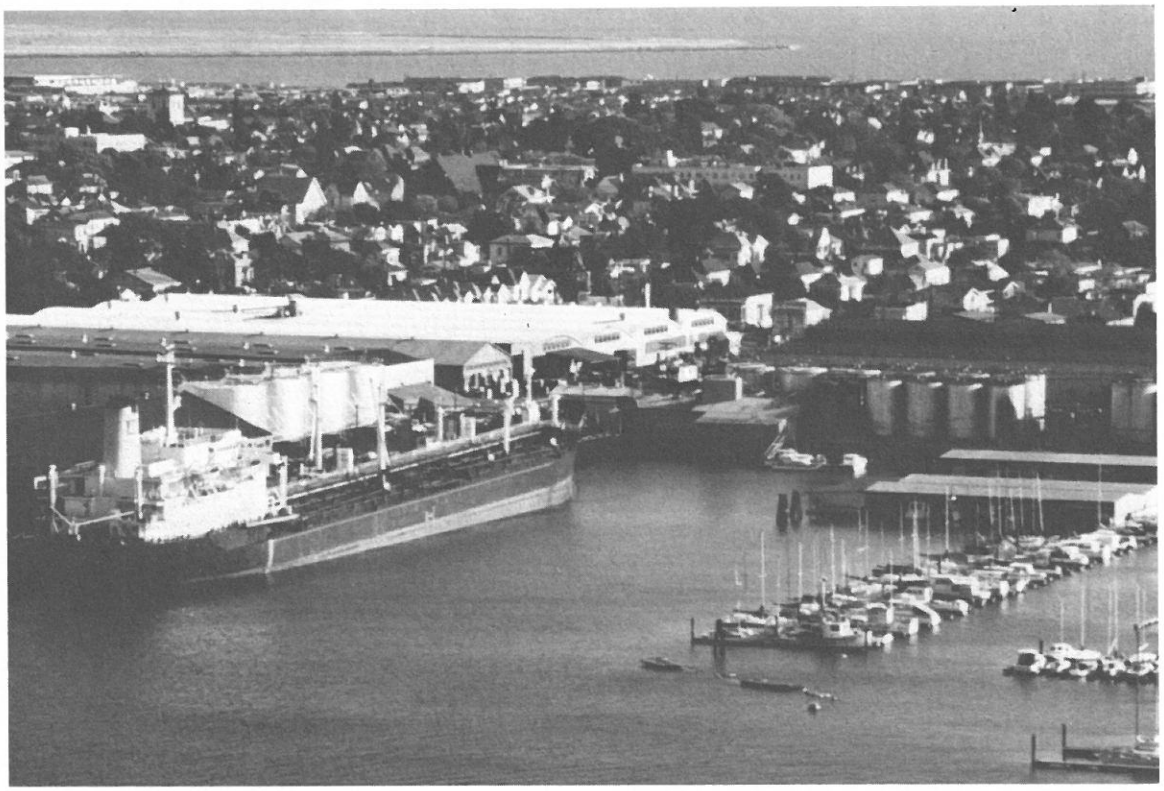
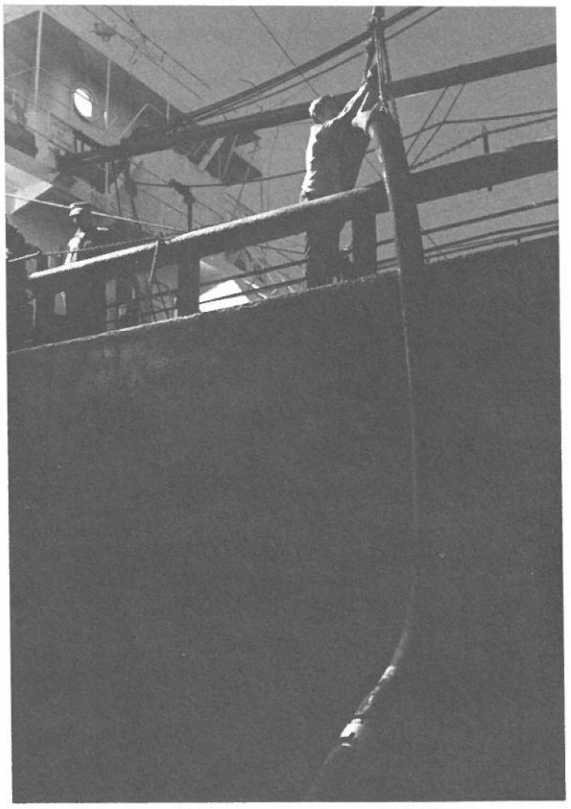




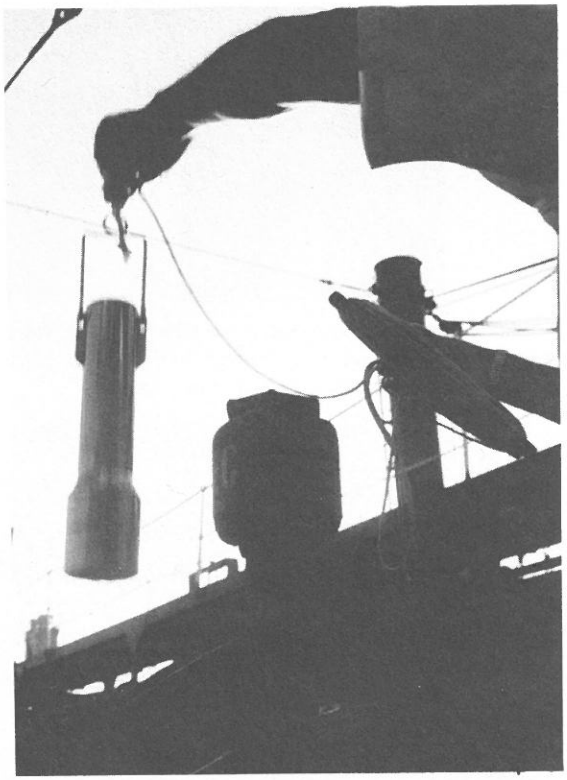
Today's renderers, however, have to be more than operators and technicians; they must also be managers. Facilities, equipment and manpower must be blended into an efficient, cost-effective operation. That is requiring an increasing amount of paperwork.



With the U. S. renderer exporting nearly three billion pounds of tallow and grease each year, the liquid bulk terminal has become an important link in the "tallow connection."

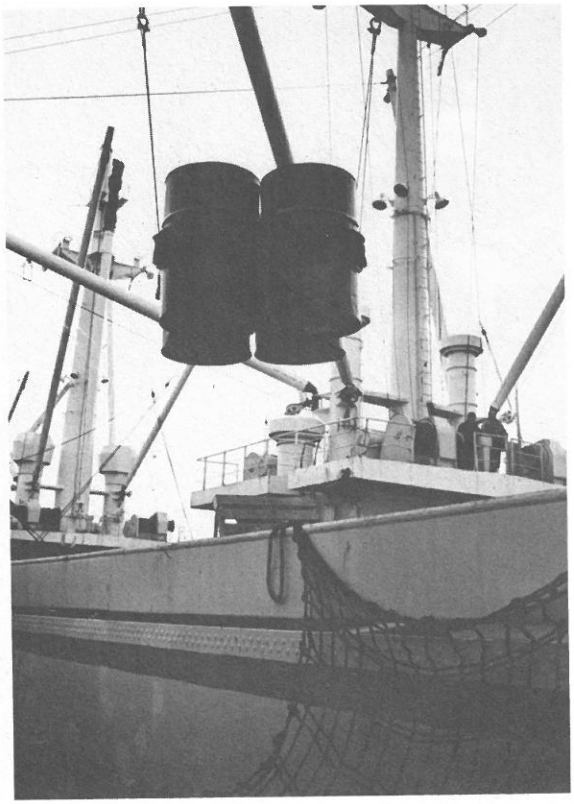


When tallow is being loaded aboard ship, the operation goes on day and night until it is completed. Tallow is steam-heated to 120 degrees to keep it in the liquid state so that it can be pumped aboard.

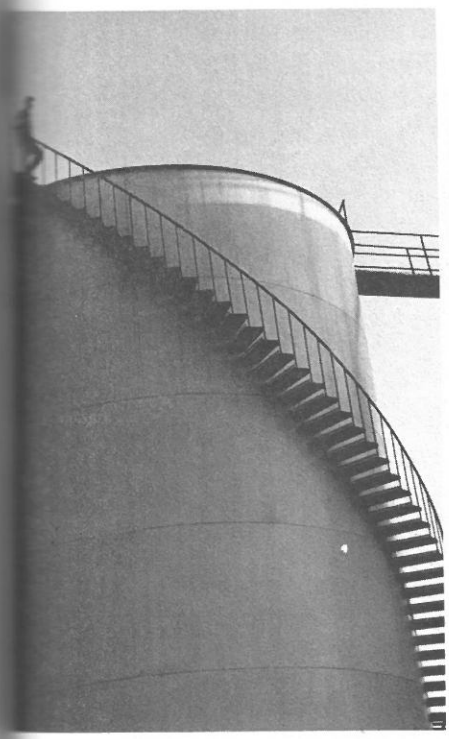


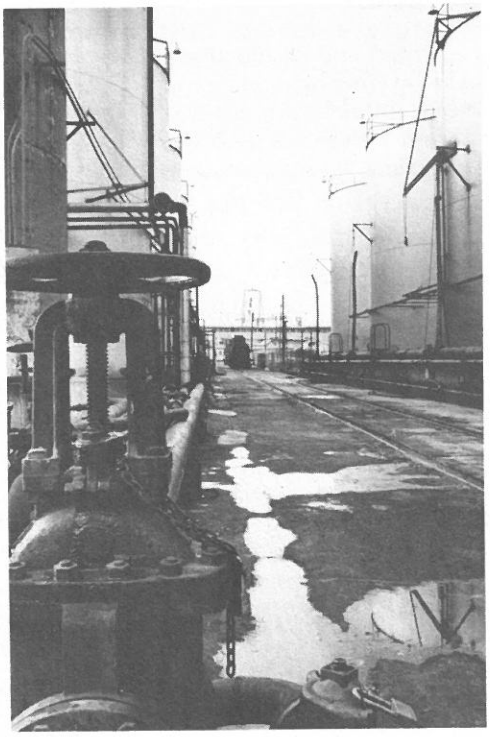
Marine surveyors carefully check each load to insure that it meets the quantity requirements and samples are taken — and analyzed — to insure that it is the product the customer has ordered.

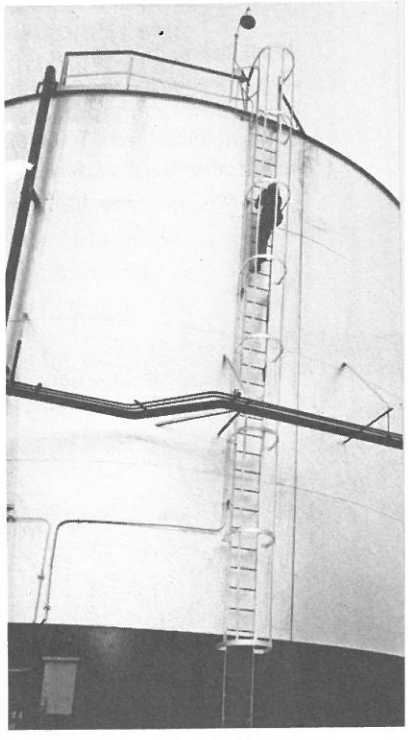
There still are some parts of the world that do not have port facilities to accept bulk tallow shipment aboard tankers. For these areas, tallow is drummed. This is another service of the terminal.



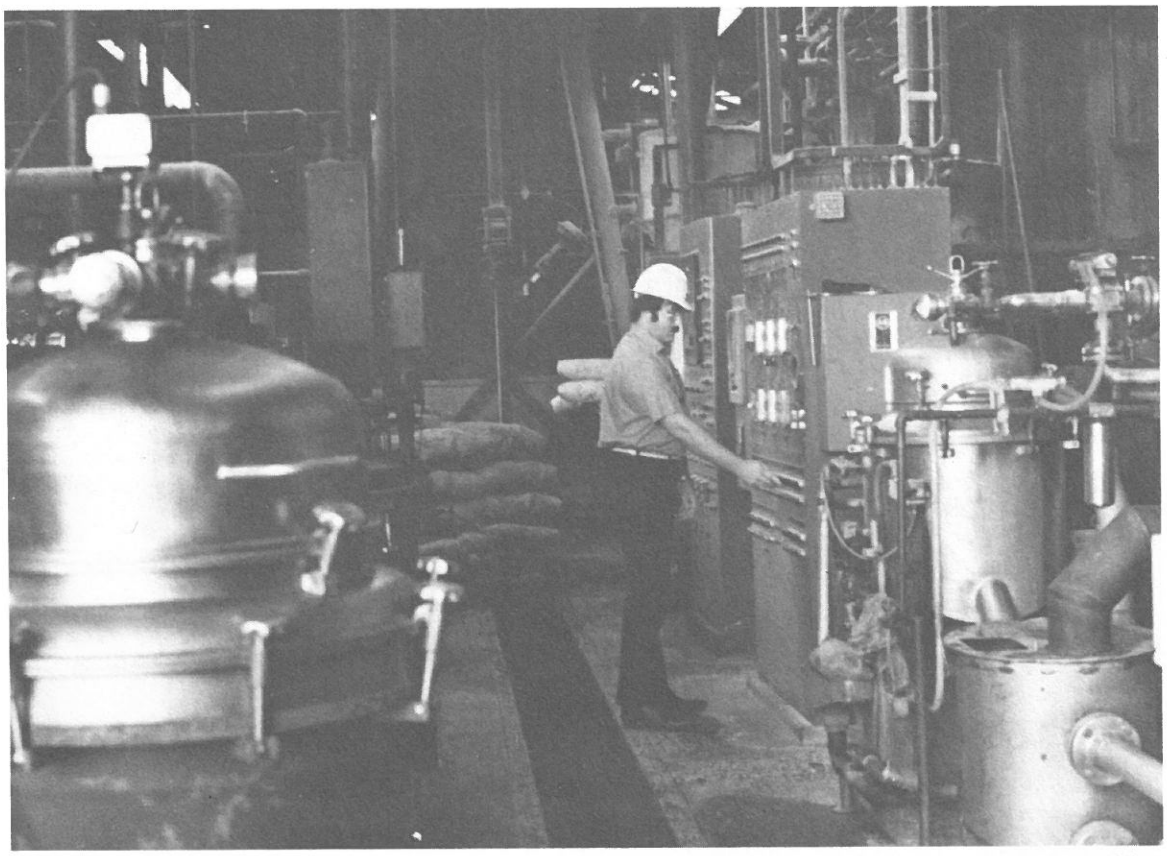
Some drummed shipments may number only a few hundred barrels. Others, like this ready to be shipped to an Asian customer, include tens of thousands of drums.





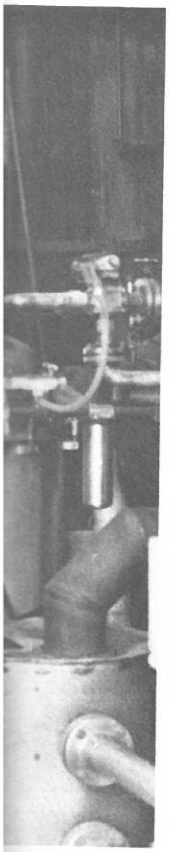


The terminal not only must provide storage and facilities for loading tallow aboard the ship, it also must provide facilities to receive the commodity by both rail tank car and highway tanker. Storage tanks must be kept clean and free of contamination and care must be taken to see that the quantity is kept intact during transfer and storage operations.



Another service of the terminal often is bleaching, refining and blending tallows to meet customer specifications. This requires sophisticated facilities.

Most tallow is shipped abroad in parcel tankers like these. Some is shipped in the "deep tanks" of other cargo ships and even occasionally passenger vessels. An increasing amount of meat/bone meal is shipped aboard container vessels but so far shipment of tallow in this fashion hasn't seemed to catch on.



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among poultry producers that a fat-fortified ration would have adverse effects on egg production.

Paralleling this educational program, NRA's Far East Office joined with Sakai Poultry of Osaka and Nichiwa Feed Mill Co., of Kobe to promote an extensive layer feeding trial. Using 20,000 layers in two groups of 10,000 (one a control group), the trial already has provided preliminary data indicating that layers fed on a ration including feed fat turn in superior laying performance over those given feed without fat.

Jack Crouse, NRA's Market Development Coordinator who generally oversees the activities of the foreign offices, sees a continuing requirement for the U.S. to conduct an aggressive foreign marketing effort for rendered products.

"We can't afford to let down," Crouse concludes,"because we can always run into new situations. There will always be competition right around the corner. We must maintain close liaison with current customers and constantly develop new ones. We must know what they want, when they want it and how they want it. That's one thing the NRA knows how to do and do well."

At the FPRF a multitude of projects always are underway. The foundation's director outlines one:

"Our earliest investigations on the nature of the constituents of the odors associated with the rendering process by gas chromatography revealed an extremely complex mixture of organic compounds including aldehydes, fatty acids, hydrocarbons, amines and sulfur compounds of which only a handful has so far been identified.

"Preliminary scrubbing experiments with prototype components of the rendering odors quickly showed that certain reagents such as alkalis were effective in scrubbing out fatty acid constituents, acidic solutions and absorbed amines and that sulfur-containing compounds and olefins could be removed with oxidants such as sodium hypochlorite, hydrogen peroxide or potassium permanganate solutions.

"A three stage laboratory tower packed with ceramic saddles was installed in parallel with the horizontal spray scrubber at a rendering plant. Air ducts leading from four locations in the plant permitted scrubbing of the various odor streams and sampling before and after treatment. Air samples were collected in specially designed absorbent sampling tubes for later analysis by gas chromatograph and mass spectrometer at the Illinois Institute of Technology Research Institute (IITRI) laboratories and in polyethylene containers for evaluation by an odor sensory panel using an IITRI-designed dynamic olfactometer."

According to Boehme, one of the significant advantages of such a system is the fact that chlorine is not likely to become in critical short supply since practical small-scale generators currently are available and the raw material is salt. While electric power is required to operate the generator, he points out, the device is not power-sensitive.

This project is only one of a score of balls Doctor Boehme has juggled in aggressively prosecuting the objects and purposes of the foundation. His budget is in the main expended in grants and research contracts with educational institutions and independent laboratories to support similar research for the rendering industry. About 20 to 25 percent of them are "defense" in nature, Boehme explains, having to do with problems en-

countered in salmonella control, water and air pollution and the elimination of polyethylene from tallow. Twenty-five to 30 percent of the projects are in the area of utilization while the remaining 50 percent or so falls in the nutritional research field.

The FPRF was established in 1962 under the overall aegis of the National Rendering Association to carry on and expand research and development initially begun in 1956. The nature of the rendering and meat processing industry is such that very few companies were able to fund independent research in by-product utilization and improvement. On the other hand, the inedible by-products of meat processing began to face ever-mounting competition from other raw material sources.

An answer was in an industry-wide program of pertinent research consisting of projects created and implemented by universities and private research organizations under the overall guidance of and with funding from the FPRF.

Obviously, rendering, meat packing and related industries cannot be expected to support pure, basic, fundamental research—investigations that may yield interesting scientific information that has no foreseeable application in these industries.

Thus, the emphasis must be on "applied" or "directed" research and development—investigations that use existing fundamental information for the development of innovative ideas for new products, new processes and new uses for existing commodities. Even this type of research and development requires large outlays of time and money in addition to innovative ideas.

Experienced researchers say that for each 100 innovative ideas 80 will be rejected without laboratory investigation because they are too far out, too much of a gamble or too costly even if successful. On an average, $100,000 (about three scientist-years) usually is required for preliminary laboratory screening of the remaining 20 and rarely do more than one or two survive this screening and justify extensive laboratory investigation and the possible pilot plant development at an additional cost of from $200,000 to $500,000.

It follows then that, on the average, a well-managed research organization may be expected to develop one commercially applied product, process or new use for each 100 innovative ideas generated and each $200,000 spent on research and development. But it must be emphasized that the average time lag from the innovative idea to demonstration is nine years.

Research and development sponsored by FPRF or conducted independently by universities, laboratories and the user industries themselves, already has resulted in the products of the rendering industry being applied in a wide variety of end uses. Tallow is basic to good quality toilet soap. Feed fat and meat/bone meal usually are found in improved feeds for poultry and cattle. Fatty acids obtained from animal fat today are being used in ever increasing quantities in the manufacture of scores of familiar products and some not so familiar. The list includes such things as abrasives, shaving cream, asphalt tile, lubricants, candles, calking compounds, cement additives, cleaners, cosmetics, deodorants, paints, polishes, perfumes, plastics, printing inks and water repellent compounds.

Among FPRF's projects has been one involving tallow-fortified rations for baby pigs. According to Boehme, this ration will increase the survival rate of the piglet with an ultimate result of increasing hog production by from 10 to 15 percent.

Under an FPRF grant Doctors Dale R. Romsos, Elvyn R. Miller and Gilbert A. Leveille of Michigan State University found that finishing pigs can utilize dietary tallow efficiently.

Investigators at Texas A&M working under an FPRF grant found that dried blood serum and globin fractions of bovine blood are "excellent emulsifiers." These proteins, Boehme says, can be made available in commercial quantities using procedures developed by Doctors W. A. Landmann and C. W. Dill.

At Purdue University, Professor W. M. Beeson and his staff have found that feed grade animal fat is an "effective source of energy" in dried corn and corn silage rations fed to livestock, while at the University of Georgia, Professor Henry L. Fuller found that "summer slump"—a hot weather phenomenon which takes a heavy toll in the broiler industry—can be inhibited by replacing glucose in the rations with poultry fat. The increased energy intake appears, in part, to overcome the effects of heat stress and permits improved growth rates.

All of these research programs were undertaken with FPRF grant support.

Since taking over the reins at FPRF in 1973, Boehme has initiated a new NRA internal program, one of providing a continuing flow of technical information written in a readily understandable manner to member renderers.

"The renderer doesn't have the time, nor is he usually familiar enough with scientific terminology to keep track of new technical developments which can help him in his daily plant operation," Boehme explains, "so what I try to do on a regular basis is to collect information and boil it down, presenting it in a straightforward manner that lends itself to quick reading and rapid assimilation. Recent subjects distributed to the field include 'removal of polyethylene from tallow in the rendering plant,' 'some hows and whys of bleaching earth' and 'thermodynamics of the batch cooker.' I am delighted with the response this new service is receiving."

Today's National Association is comprised of seven regional renderer associations, some simply regional breakouts of the national association like the NRA First, Fourth, Fifth and Seventh Regional Area associations, while others, like the Southeastern Regional Renderers Association, the Rocky Mountain Renderers Association and the Pacific Coast Renderers Association (generally known as the PCRA), maintain a more positive regional identity.

PCRA is one that not only has a strong sense of local identity but also carries on its own aggressive area programs, some paralleling those of the parent association but localized to meet specialized area problems, and others in which the West Coast renderers have emerged in a pioneering role.

In 1971 for instance, the PCRA, recognizing that the rendering industry had no industrial trade publication of its own (what editorial identification it got was derived from piggyback coverage in meat industry

publications), funded a major program to create a professionally-edited-and-produced national magazine for the industry. That publication, RENDER, now is in its seventh year and already has won national honors for editorial and graphic excellence. Although its editorial coverage is nationwide in scope and its circulation international—totalling nearly 8,000—PCRA continues to provide substantial financial support.

Beginning in 1972, PCRA launched its own massive external information program (at a cost of more than $100,000 in the first three years) designed to acquaint the public with the many contributions the rendering industry makes to society.

To further enhance the prestige of the industry, PCRA commissioned a California artist/sculptor to produce a suitable national award to be given in recognition of "outstanding sustained contributions" to rendering. Called the "Tallowmaster," the bronze figurine—the "Oscar" of rendering—is that of a seventeenth century renderer working at the melting pot of the era.

The rendering industry in the United States had come a long way since those roaring twenties days when Zapoleon lectured it on the need to form a trade association. Today the nation's independent renderers through their trade associations are well equipped to accomplish what must be done to insure that these original recyclers continue their increasingly significant contributions to mankind.

8 THE POLLUTION PROBLEM

Since the first stockyards and slaughterhouses were established in communities destined to become regional and local distribution points for fresh, dressed meats and the first rendering facilities were built to recycle those parts of the meat animals not destined for human consumption, society in general and in particular those members of society who lived or worked in immediate proximity to those plants and yards learned quickly that there were certain unappetizing aspects to these undertakings.

Animal flesh, once the spark of life is quenched, quickly spoils and, approaching the state of putrification, emits strong, disagreeable odors. Until the advent of high speed transportation, modern high volume rendering equipment, and elaborate odor control systems, the renderer's raw material usually—as the phrase goes—"stunk to high heaven."

As a result, in locating his plant, the renderer usually had to strike a happy medium—be as far away from the rest of the community as possible and still keep his lines of supply as short as possible. At the very least, the rendering plant always ended up on the "wrong side of the tracks." Insofar as his business activity was concerned, the renderer found himself shunned. Then seeking anonymity, he literally became invisible, remaining in the shadows of American industry for well over a hundred years.

Throughout the latter part of the nineteenth century and more than halfway through the twentieth, the renderer, acutely conscious that his manner of livelihood was basically offensive to his neighbors, quietly lived with this stigma, yet each year made an increasingly important contribution to society. In all probability, he still would be functioning in this manner if it had not been for the era of environmental awareness that exploded on the nation and the world with the decade of the 1970s.

Society suddenly became aware that the growth of industry and technology—the same growth that provided new means of transportation, communications, sophisticated labor-saving devices for the home, new avenues of recreation and the increased leisure time to enjoy them—was not without cost. The unwanted by-product of this progress was polluted air and water. Vocal environmental activists provided huge amounts of grist for the media mill and quickly America's newspapers and magazines, radio and television stations became the tellers of doom.

In retrospect it probably can be said that the situation was extremely bad. If left unchecked, air and water pollution—at the rate they were going—would be a serious threat. But, it does not now appear that it warranted the wave of environmental panic that swept the nation between 1970 and 1975 or the hasty enactment of the new laws and regulations—many of them legislatively weak and poorly constructed—which now pose a serious threat to our economic well being.

Fortunately, some of the legislation enacted by the Congress was sound and already it has facilitated significant control of hazardous compounds

being spewed into the air from our industrial complexes and it is having a significant impact on what had become a common practice—dumping industrial wastes into our rivers and lakes.

What has been unfortunate, however, is the fact that the renderer—particularly in the area of air pollution—has been characterized as wearing the same "black hat" as steel, pulp paper, chemical, refining and similar industries which do emit large quantities of material which have been determined to be hazardous to health into the air. Yet, the renderer's worst offense is that he may make the air smell bad.

The situation is not dissimilar in the area of water pollution. Society has been horrified, and perhaps rightly so, by the toll taken when an offshore oil well blows out, covering a hundred miles of beach with a mineral compound that kills plant and animal life alike. Stringent regulations have been promulgated to force industry to take appropriate safeguards to prevent these kinds of disasters. Here again the rendering industry has been miscast as one of the villains. The renderer does deal in oils—animal fats and oils, not mineral oils. Animal fats and oils are fully biodegradable—they break down in solution and return to nature. Scientific tests have proven they are not toxic to plant and animal life. True, they are messy and a spill does require a timely clean-up operation. But, they, like the disagreeable odors emitted from a rendering plant, do not constitute a hazard to life or health.

In the early 1970s it was estimated (based on a report compiled by the National Industrial Pollution Control Council) that the nation's meat, poultry and rendering industries would have to spend some $222 million through 1976 to comply with existing and proposed standards for air and water quality. Well over a third of that would be spent by the rendering industry alone. During the same period, it was estimated that capital, operating and administrative costs in these industries could increase by a whopping $384 million. These estimates did not reflect the additional costs extending on into the early 1980s that would be involved in meeting the "best available technology" or "zero discharge" standards proposed for that time period.

Based on the NIPCC report the closing of a sizable number of rendering plants—as many as 60 by mid-decade—was forecast by the industry. And as many as 124 rendering, meat packing and poultry processing plants were expected to shut down. There is every indication today that these predictions came to pass and then some. The plants that have closed primarily have been small, one-unit operations located in rural or semi-rural areas, which could not generate the capital necessary to install the necessary pollution control equipment.

Plant closings are not expected to have a significant effect on total production. Nevertheless, such closings are likely to have a disproportionately large effect on the economy of smaller communities in which the plant provides a major source of employment for the population. Serious socio-economic effects on many laid off employees undoubtedly will result, however, because these plants tend to be also located in rural areas with minimal alternative sources of employment.

Research needs and priorities called out in the report included improved in-plant control and operation as well as certain new systems—including a "new dynamic odor sensory method to replace the

American Society for Testing and Materials (ASTM) syringe method" and a new odor control system for inedible rendering systems. In most cases, the recommendations in the air pollution control area involved research that was already underway or nearing completion such as a new odor sensory method in final stages of development under the auspices of the Fats and Proteins Research Foundation.

However, in the areas of water pollution control, the recommendations made it clear that significant advances in research and development still would be necessary. New waste recovery or treatment techniques called out for "replacement or augmentation of existing out-of-plant control methods" included these:

- reduction in fat, oil and grease (hexane solubles) discharge levels through application of "novel physical and/or chemical emulsion breakers and improved clarification equipment";
- elimination or reduction in nutrients, principally phosphorus and nitrogen present in treated waste discharges which are alleged to promote eutrophication of receiving waters;
- recovery of soluble and colloidal proteinaceous matter in wastewaters for edible or inedible use.

In the area of waste by-product utilization, the report called for research—as a long-range objective—into collection of blood by techniques permitting "edible use of the currently inedible by-product" and recovery of soluble and suspended proteins from wastewaters for "inedible purposes."

In summation, the report concluded that "the cost for pollution control will continue to have a significant impact on earnings in the meat, poultry and rendering industries.

It can readily be seen that a major key to odor control for the renderer is an accepted, scientifically valid method of measuring odor. In many jurisdictions today regulations prescribe the ASTM syringe method while others use a "Scentometer." Some have no standard method for measuring an odor.

The ASTM syringe method consists of taking samples with a prescribed vessel and then diluting them with odor-free air to predetermine odor dilution levels. These are presented to a panel of eight persons. The median odor threshold level is defined at that dilution level where 50 percent of the panel "barely detects the diluted odor stimulus."

This method is slow and cumbersome. The panel member must smell momentarily a rapidly expelled pulse of odorous air from the syringe. This method lacks a defined procedure for odor stimulus presentation since the various odor dilutions are to be randomly presented to the panel by mixing the odor of strong or weak odor stimuli. Since a weak stimulus is much less detectable after a strong one, this approach can result in a false response. Further, this method has no satisfactory provision to check the reliability of positive-negative responses of the panel.

For ambient air odor measurement, the "Scentometer" also has a history of compliance use across the country. This instrument consists of a small rectangular chamber that contains two sniffing tubes for insertion into the nostrils. Normal breathing draws the odorous air from the surrounding environment through the bottom panel and also through the two side panels which contain activated carbon to provide odor-free air for

dilution. The bottom panel is provided with four holes of varying diameter to vary the dilution ratio.

The Scentometer has three basic disadvantages. First, this instrument is normally used by only one individual. Odor sensory responses by different individuals are highly subjective. In odor sensory work conducted by Illinois Institute of Technology Research Institute, (IITRI), a tenfold variation in sensitivity normally was found to exist between panel members. Occasionally the difference was as high as a hundred fold. The Scentometer method does not provide for the selection of an odor sensory panel to average out high and low individual responses. Also, the construction of the instrument does not provide positive means for an individual to isolate his or her nose from the odorous environment being monitored. Depending upon the pattern of breathing and ability to seal off the nasal passages with the two sniffing ports, it seems reasonable to expect that any odor in the ambient air could bypass the instrument and be sensed directly by the nose, thus resulting in a false positive response. Finally, the Scentometer inherently is limited to diluting the odor stimulus to four specified levels and there is no adequate provision for achieving a graduated degree of dilution between adjacent levels. Since a number of Scentometer regulations specifically are setting limits at low levels (two and seven odor units) to define an objectionable odor nuisance for either residential or non-zoned areas, it is essential to have available an odor sensory method that is capable of accurately determining the odor dilution level at these lower levels.

The National Renderers Association has been concerned for some time about the reliability of the ASTM syringe and Scentometer methods. As a result, a project was initiated under the Fats and Proteins Research Foundation (FPRF) with IITRI to devlop a dynamic method where the diluted odor stimulus continually is discharged at a controlled flow. The dynamic olfactometer is based upon a "forced-choice triangle" statistical design. One diluted odor sample and two non-odorous air blanks are present continually at each dilution level. Each panelist is required to judge which of the three ports is odorous and to signal a choice. The three ports are arranged in a circular symmetrical pattern to achieve a "double-blind" sample presentation since neither panelists nor the panel leader know the correct choice until after the judgment is made. The results can be related to statistically significant confidence levels. For a nine member panel, a correct choice by six panel members would indicate a 95 percent confidence level that this did not occur by chance.

The test work is complete for applying this method to measure stack emission odors. This includes relating its odor test results with those obtained by the ASTM syringe method. Work now is underway to apply the IITRI dynamic method to ambient odor sensory measurement and relate its results to those obtained by the Scentometer. To date, however, the new method has not been generally accepted.

Dr. James Cox, author of *Odor Control and Olfaction,* and former director of research and development for Martin, Robertson & Bain Ltd., a major Canadian food processor, feels strongly that there is more to the picture than meets the eye. He raises a number of significant questions other than the facts of a reported odor and its measurement.

According to Cox, "Odor, especially the mal form, is undeniably the

most unpopular topic among renderers. In view of the many expensive, frustrating and unsatisfying experiences, the renderer encounters on this issue, this is understandable.

"Paradoxically, deodorizing is a principle effect of the rendering process. In essence the renderer is a professional deodorizer. Unpleasant odors are removed from raw materials, leaving a residual, acceptable odor. Further, odor development is arrested by stabilization of the rendered product. Actually, the rendering process does not eliminate, though it may alter, the odors it treats. By volatilization it merely transfers the odors from the product to another medium. This medium is normally the ambient air.

"There is considerable that the renderer can do to eliminate the odor problem.

"One sad experience after another has shown one of the most important odor control measures is proper attitude. A well conceived and executed odor control program yielding good results will be of little or no avail if the renderer fails his 'attitude test.' In addition, odor problems often are misleading. There are many cases where a slight odor problem is attended by drastic measures against a processor by authorities, media and public outcry. At the root of this situation is often found what we have termed the 'hypermotivated complainant,' or HMC. This complainer may be reacting abnormally to the basic material the renderer processes. He may erroneously believe that a slight (perhaps perceptible only to the complainant and otherwise innocuous) odor is injurious to his health. He may be in hopes of selling property at an inflated value or believe that its values have been damaged. There might be some person in the rendering operation he doesn't like. In addition, some people complain to gain notoriety or attention as the focal point of a local newsworthy enterprise. Exhibitionism takes many forms.

"The well intentioned pollution control authority often aids and abets the HMC by instituting such attention-getting attractions as 'hot lines,' inviting complaints later quoted in the media or by doing surveys in the processor's area. This form of Parkinsonian madness often yields complaints from otherwise uncomplaining individuals, justifying the need, it would seem, for more authority. This psychology feeds on itself, often creating problems where in reality none exist.

"Actually, most authorities are as frustrated as the processors. Unfortunately, they are responsible only for enforcement and primarily are not technicians. Their efforts, therefore, to a great extent are dependent upon such research, development and experience as we presently are accumulating.

"The complaints of the HMC may in turn generate additional complaints by relatives, friends, business dependents, or by just plain suggestion. It has been shown conclusively that hope of gain, or fear of loss results in markedly increased sensitivity to odor perception, with 20 times normal threshold perception increases in acuity and considerable increases in subjective recognition of odors which did not exist being reported. In addition to the psychological HMC, there are those who suffer from temporary or permanent hyperosmia, which is often represented by an increased sensitivity of up to 20,000 times normal to a given odor. This is not uncommon. To date, no known remedial process or combina-

tion of processes which might be employed by the renderer will alleviate these types of problems and, unfortunately, they are seldom, if ever, considered in the disposition of an odor problem.

"Many jurisdictions permit the issuance of a citation based on phoned complaints without any attempt at verification. This subjects the renderer, as well as other odor prone processors, to rather arbitrary, capricious, often illogical enforcement.

"A question which sooner or later must be answered is, 'if the motivation is abnormal, does the reaction to odor constitute nuisance, or is the abnormal motivation which gives rise to the reaction nuisance?'

"We have determined that there is much more involved in effective odor control than the mere elimination of odor. As a matter of fact, our experiences indicate these factors to be frequently, if not always, more significant than any actual odor present.

"We believe that to a great measure these problems will be overcome by a combined approach involving improved methods of objective monitoring and detection; development of practical odor control products, procedures and workable equipment; good comprehension, insight and understanding of specific odor problems; and finally, accumulating sufficient knowledge and expertise to command the respect of the public and the authorities."

It is unfortunate that more pollution control enforcement personnel, particularly those at the community level, are not as well equipped or motivated as is Doctor Cox to take into consideration the many psychological aspects of human reaction to odor stimuli. Industries like rendering which are "odor prone" are, in fact, rapidly approaching the point of being "odor oppressed" and there isn't an apparent serious concern being expressed in the circles of officialdom. Where actual odor problems exist and where the renderer has the financial wherewithall to install state-of-the-art control equipment, the problems of air pollution by and large are being brought under control. Air scrubbers and afterburners appear to meet even the requirements at least insofar as odors resulting from the actual rendering process.

While they must enforce the rules and regulations applyng to nuisances (such as the renderer's odors) with the same vigor required to prevent the emission of dangerous pollutants into the atmosphere, some air pollution control authorities admit privately that they "probably could do a better job where it really is needed if we didn't have to go around chasing bad smells for people with over sensitive noses."

The Environmental Protection Agency (EPA) does not comment, but it is apparent that this fact came in for consideration when it was decided to drop rendering from the list of "high priority" industries for which national air pollution standards were promulgated. Essentially, however, emphasis on odor control has not lessened either at the industry level or the community level and equipment to accomplish this is a large factor in the increased costs faced by all renderers both in terms of retrofitting older plants and in building new plants.

Although air pollution regulations are becoming more stringent every day across the nation, in most areas local procedures do not yet specify the exact methods and equipment required to do the job. In Los Angeles County, CA, however, they are specified and moreover are called out for

the "reduction of animal matter" or, in other words, rendering. The Los Angeles regulation stipulates that "a person shall not operate or use any article, machine, equipment or other contrivance for the reduction of animal matter unless all gases, vapors and gas-entrained effluents from such an article, machine, equipment or other contrivance are:

"a. Incinerated at temperatures of not less than 1,200 degrees Fahrenheit for a period of not less than 0.3 seconds or,

"b. Processed in such a manner determined by the Air Pollution Control Officer to be equally or more effective for the purpose of air pollution control."

The regulations also provide that such equipment will be installed, maintained and calibrated in accordance with specific guidance provided by the Air Quality Management District (AQMD).

Since Los Angeles—city and county—represents only a single relatively small area of the United States, some might ask why its air pollution control philosophy and regulatory measures are singled out for this much attention. The Los Angeles area has pioneered in strong air pollution control action; it has served as a model for much of the work being undertaken on a national level; and history already is proving that air pollution control thinking developed in this area has quickly spread to other parts of the country. Renderers, particularly those in urban environments, face equal or stronger control measures.

To date the concern with air pollution has exerted the greatest immediate influence on the rendering industry but—and again Southern California regulatory agencies are leading the pack—tough, new water pollution requirements are constantly emerging. Water pollution control measures as currently implemented in Los Angeles County present an either/or situation—either the renderer lays out a large capital investment in water clarification equipment or he pays a prohibitive, new sewer tax based not only on the volume and flow rate into the sewer system but also on the discharge of suspended solids and chemical oxygen demand (COD) and peak discharge rates.

The tax consists of four separate assessments: (1) $127/million gallons/year of water discharged into the sewer; (2) $6.60/thousand pounds/year COD; (3) $16.10/thousand pounds/year of suspended solids; and (4) a multiplying factor accounting for increased government costs due to high ratios of industrial discharger peak-to-average flow rates.

Among the pollution control methods available are grease skimmers, settling basins and aeration ponds. But, most of these are too costly in terms of the expensive real estate needed. Also, in urban areas this real estate just isn't available.

In many areas, urban renderers also are faced with an apparent conflict in the requirements of air pollution control and those imposed for water pollution control.

Normally, in modern systems, it is the practice to use a condenser between the cooker and the afterburner to collect the condensable gases. This reduces the work load on the afterburner. The renderer is obligated to discharge these condensables into the sewer system. But, until some effective method of water clarification is introduced, this runs up the sewer tax. It puts the renderer in a damned-if-you-do, damned-if-you-don't

position.

"We don't dictate that the renderer use a condenser and therefore we don't dictate that any additional pollutants be discharged into the sewers. We are perfectly happy if he just uses a larger afterburner—one that can incinerate not only the gases but also the condensables. It does make it rougher on the renderer, however, because either way it is going to cost him more money. But that's the way it is. It is going to cost money to reduce the pollution of our air and water."

Still other Federal legislation—OSHA, the Occupational Safety and Health Act—imposed additional requirements and costs on industry.

"You had better be thinking about the noise problem," renderers are warned.

The decibel level (db) of the average hog runs as high as 110-155. Gas-fired boilers go as high as 90 db in the vicinity of the boiler. Hammer mills also produce a noise level in the 110-115 db area.

At present the absolute top level permissible is 90 db and from there it is charted on a logarithmic scale. For instance, under OSHA regulations a workman can only put in five hours a day in a 95 db noise level environment.

Jack McCallum, president of Darling-Delaware, reports his company has spent millions in the past several years insuring that it meets current OSHA, air pollution and water pollution requirements.

"This is just in cash outlays," McCallum says, "and there is no real way to determine the additional costs imposed by slow down in operations. To meet many of the requirements, particularly air pollution control, it is necessary to confine your plant. The more you confine it, the more you slow your process. This costs money. Also, it requires more energy to convert the moisture in the raw material to steam and more power to convert it back into water or to incinerate it.

"We are talking about an energy crisis. This is where the real pinch may come. We used to require half as much horsepower for pollution control as we did for rendering. Now it is even—we need as much horsepower for pollution control as we do to accomplish our main industrial task, rendering."

Don Heddleston, vice president for the Southern Division of Peterson Kane-Miller, says that Peterson is encountering an across-the-board 20 percent increase in overhead as the result of meeting the many new standards and requirements in its 10 plants in California and Nevada. In Brawley, CA, for instance, the company installed an "activated sludge removal" system. This is a system in which bacteriological cleansing of the discharge water is accomplished through the introduction of enzymes while the water is contained in a series of holding ponds. Chlorine treatment prevents an odor problem during the enzymetic process. This system is ideal for the rural rendering plant, he says, and can be tailored to any size facility. It does, however, require substantial real estate. Thus, it is not the answer to meeting the urban renderer's needs. Peterson is seeking an appropriate clarification system for use at its Los Angeles plant where the company faces the same sewer tax situation as many other urban renderers.

"We're looking for the best system," Heddleston says. "This is an industry-wide problem and I'm sure that whoever comes up with the

answer will share it with other companies. I'm equally sure other companies will be glad to get it. There is little question but what any good clarification system will prove to be cheaper than the tax."

Heddleston feels that from many points of view the pressures of the environmental concern may well be a "blessing in disguise."

"From a technical viewpoint," he says, "the renderer has had to investigate himself and get more educated in terms of not only new technologies but also his own process. Many times things are forced upon us that, with thought, we can turn to our advantage. I think this is one of those times.

"Look at OSHA, for instance. The guy that doesn't recognize that safety pays for itself won't be around in the end anyway. An employee is an asset that far outlasts any piece of equipment. Realizing this, you are willing to go to almost any length to insure that your employees are safe, healthy, productive and loyal."

By 1980 the rendering industry in the United States will have spent something in excess of $100 billion over a five-year period to meet the requirements of what Dr. Murray L. Weidenbaum, director of the Center for the Study of American Business, calls a revolutionary change in our national economy.

Weidenbaum, a former Assistant Secretary of the Treasury for Economic Policy and a fiscal economist for the Bureau of the Budget, maintains that businessmen who are responsible for profit and loss no longer have full freedom to make the profit and loss decisions. More and more of the decisions of business management that affect profit and loss are being controlled and influenced by government agencies "that are isolated" from the pressures of management responsibility.

"Increasingly," he says, "the power to make business decision is being taken away from management and assumed by government. The problem is that these government officials and government agencies are not responsive to the pressures of profit and loss and, though their decisions affect management, they have no management responsibility."

An example of the problem is the dilemma faced by a renderer who wants to build a new plant. If it violates the standards set by the Environmental Protection Agency (EPA), he can't build it. For instance, he wants to conform, take extraordinary precautions to insure that he is "clean" with local, state and EPA air quality regulations and, more important, with his neighbor's noses. Now he finds that in cleaning up the air he is guilty of polluting the water.

"There is such a proliferation of government regulations," Weidenbaum points out, "that in trying to obey one, you run afoul of another."

Charles Hausserman, former Darling-Delaware chief executive, points out:

"Thirty-five percent of the cost of a new plant costing from $1 to $1.2 million goes into water and air pollution control equipment."

Bill Heil, manager of Engineering Services for National By-Products, recently went through the "big sweat" designing and building a brand new rendering plant at Mason City, IL, and bringing it on stream in the regulatory environment that characterizes the 1970s. The new plant—actually a new rendering plant and a rebuilt associated blending/refining facility—cost National By-Products just over $4.8 million.

Sewage treatment, Heil reports, for delivery of the effluent into a municipal sewer (and this isn't as expensive as it is for a plant delivering its effluent into a stream or river) cost a half million alone. The addition of new air pollution control equipment and the modification of some existing equipment added another $300,000 to the bill.

In the OSHA area, Heil saw only a modest additional expense—about $20,000—again because with a new plant the OSHA requirements largely are met. One specific action planned into the facility to meet the OSHA noise regulations which now are being promulgated was to physically separate the noise sources so as to reduce peak decibles in certain areas.

"This probably is the least many renderers are going to have to do," Heil feels, "once the noise regulations are finalized and put into effect."

The new, high capacity, continuous rendering systems which are becoming the standard of the industry, he says, are "hard put to keep the ambient noise within the 90-decible limit now planned." Heil doubts the systems could meet the limits if they are reduced to 80 or 85 db.

Another area of future concern is the air pollution control requirements planned for commercial vehicles—truck fleets—especially the growing number of diesel engine trucks in use. This could become a major item on increased overhead.

So far we have the comment of major renderers. What about the small-to-medium-sized rendering plant?

Charles Tocalino, president of Modesto Tallow in California's San Joaquin Valley, is representative of this group. Until 1973, Tocalino had only the Modesto facility which is of recent vintage—only 10 years old. Since then he has built a new plant in Dixon, CA.

Tocalino reports that in a three-year period he had to put an additional $180,000 into his Modesto plant to meet air and water pollution standards imposed by new regulatory actions. To this must be added $100 a day in additional operating expenses. Since the Modesto plant was built only 10 years ago, it met 95 percent of the OSHA requirements so little expense was incurred there. With the new Dixon plant, he says, 25 percent of its cost went to meet air and water pollution requirements.

"It costs almost as much," he adds, "to remodel than to build new. The amount is little more and you then reap the benefits of a new plant—better production, less labor cost and better quality control."

There can be no question but what the rendering industry no longer is invisible, particularly to the Federal, state and local agencies responsible for enforcing the plethora of environmental laws and regulations born of the 1970s. Its problem is no less a problem than that of most of American industry in that the cost of meeting air, water and (in the immediate future) noise pollution control requirements already has reached staggering proportions and in that many companies already have been forced to close their doors because the cost was more than they could afford.

It is unfortunate, however, that much of the renderer's problem is the result of a lack of understanding on the part of the general public as well as on the part of regulatory officials who cannot or will not draw a distinction between pollution that constitutes no threat, only a nuisance, and that which presents a clear hazard to life and health.

FOCUS ON THE FUTURE 9

A period of major transition, transition that is far from completed, is perhaps the most accurate way in which to describe what has occurred and what will continue to occur in the rendering industry during the latter half of the twentieth century.

Environmental considerations, particularly in terms of water and air pollution control requirements, will continue to have a major impact especially with regard to the economics of doing business. The situation is not unlike that faced by many segments of agriculture—smaller operators who do not have the financial wherewithall to make substantial capital investments may fall by the wayside.

Another major concern is the problem of dwindling energy sources. Traditionally, steam generated by burning conventional carbon fuels, has been the principle form of energy used to support the rendering process. The spectre of massive oil shortages as petroleum-rich nations attempt to force the United States to bow under a variety of political demands is of great concern to the renderer.

Many renderers switched from oil to natural gas during the crunch of the mid-70s only to find that a series of economic considerations had caused gas suppliers to neglect the development of new sources. The result: natural gas also became in short supply and gas prices skyrocketed. Faced with the possibility of future oil embargoes as well as with a critical balance of payments situation and with probable shortages of natural gas, particularly in view of the constantly increasing demand for energy by industry and the public, the Federal government began urging conversion from oil/gas to coal. This in itself is described by the experts who design and provide coal-fired systems as "incredibly expensive."

Changes in Federal meat grading regulations, together with the trend toward prefabrication of meat cuts at the packer level (breaking down the carcass into primal and sub-primal cuts prior to shipment to the retail level), pose still another problem area for the rendering industry, at least as it is configured today. According to a 1977 study conducted by a company involved in space-age wrapping material used in preparing prefabricated meats for storage and shipment, these cuts accounted for 57 percent of total U. S. beef receipts (excluding ground beef) in 1977. This percentage was expected to climb to 64 in 1978 and by 1980 primal and sub-primal cuts will account for 72 percent of all beef sold by the nation's large markets.

Recent grading changes (1976-77) and others in the proposal stage tend to have the effect of insuring that more fat and bone is trimmed from the carcass at the slaughterhouse/packing house level, leaving less to be trimmed when the meat is prepared for retail sale at the local level. This in itself could have a significant impact in terms of geographically relocating major sources of the renderer's raw material. Certainly, the move toward central fabrication can only aggravate this situation and, since it appears to be economically sound to situate central fabrication facilities adjacent or at least in relatively close proximity to the major slaughtering centers, the result could be a serious shortage of raw material

in the areas served by the majority of the large, metropolitan renderers particularly in the heavily populated coastal areas and a huge, over supply of raw materials in the traditional midwest slaughter centers.

Such a relocation not only will place a hardship on the coastal renderer but it also will require either that the slaughterer/packer make a major investment to increase his capability to render on-site or that independent renderers in those areas pump large sums into expansion of existing facilities. Still another effect will be a boost in the prices sought for tallow, feed fat and animal protein from these areas. It is generally accepted that the capital investment required plus the additional costs of shipping large quantities of finished product from the central states to domestic consumers in the coastal areas and to U.S. export customers abroad will substantially increase costs, make U.S. rendered products less competitive for foreign customers and in the long term have a deleterious effect on the U.S. balance of payments.

Obviously, the renderer also must be concerned with the many other outside forces that impact on U.S. business and industry as a whole—inflation, skyrocketing costs of the many forms of insurance required today, increased governmental red tape like the blizzard of paperwork required by ERISA—the Employee Retirement Income Security Act of 1974.

Energy shortages, inflation, the impact of governmental actions and changes in the meat industry are not the only challenges the renderer must face over the next decade. He also is confronted by consumer communities growing more sophisticated each day. As we have seen, the poultry rancher, once satisfied with meat/bone meal analysis setting forth the protein level, now must know the calcium, ash and amino acid content of the product. Soap manufacturers and fatty acid splitters are demanding a product not only of substantially higher quality but also with a significantly greater consistency as to quality load-to-load. The whole trend toward "tailor-made" products is, in fact, apparent in the advice being offered the rendering industry in the late 1970s by the major pet food manufacturers.

Renderers cannot expect that specifications for such products will soon be written by the pet food producers, but, that is the type of product—especially with regard to meat/bone meal—the pet food industry wants and renderers who are responsive to that requirement should find they have the inside track in that marketplace.

The American housewife, who buys most of the pet food consumed today, is becoming as particular about the quality of the food eaten by the family dogs and cats as that placed on the dinner table. As a result, regulatory requirements have been established by the government which insure that all ingredients in pet food are properly identified and listed on the package.

These ingredients must conform with statements made on the labels. If meat/bone meal is listed as an ingredient, the manufacturer cannot substitute a meat meal without changing the label, nor can he substitute mixes containing other meals even though they may be equivalent in proximate analysis to meat/bone meal.

The Pet Food Institute has adopted standards established by the National Research Council for "complete" pet foods. If a product is represented as being a complete pet food, feeding tests must "prove that it

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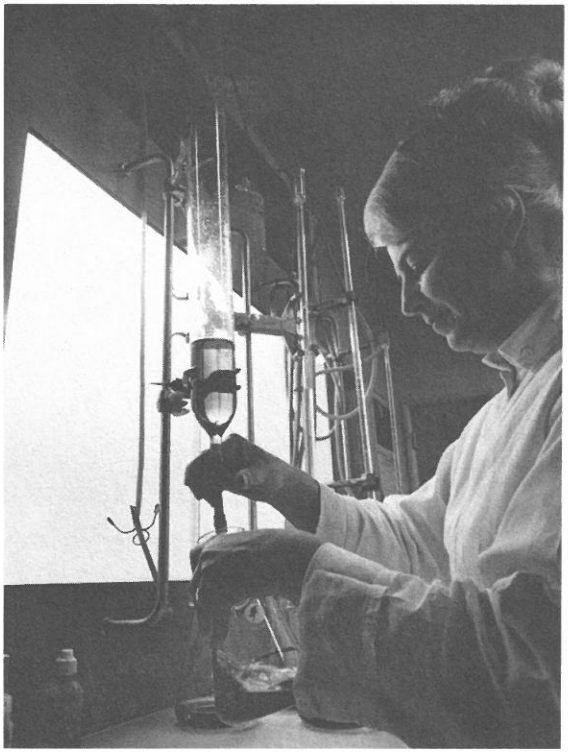
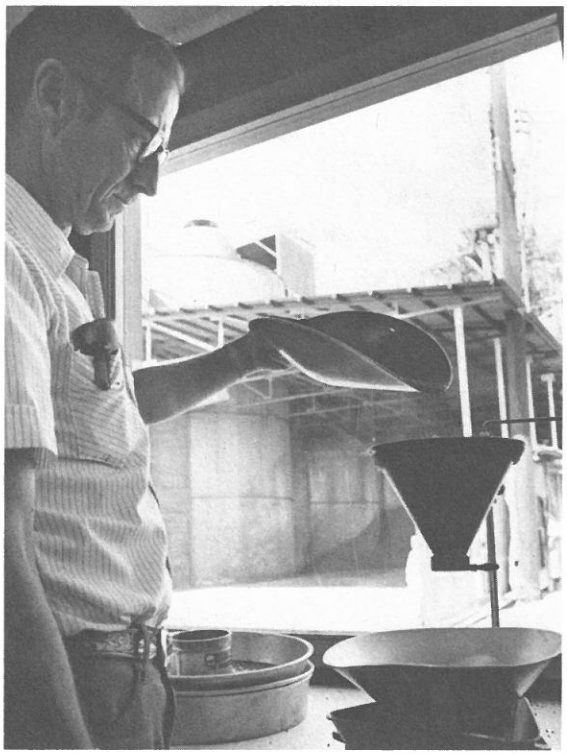
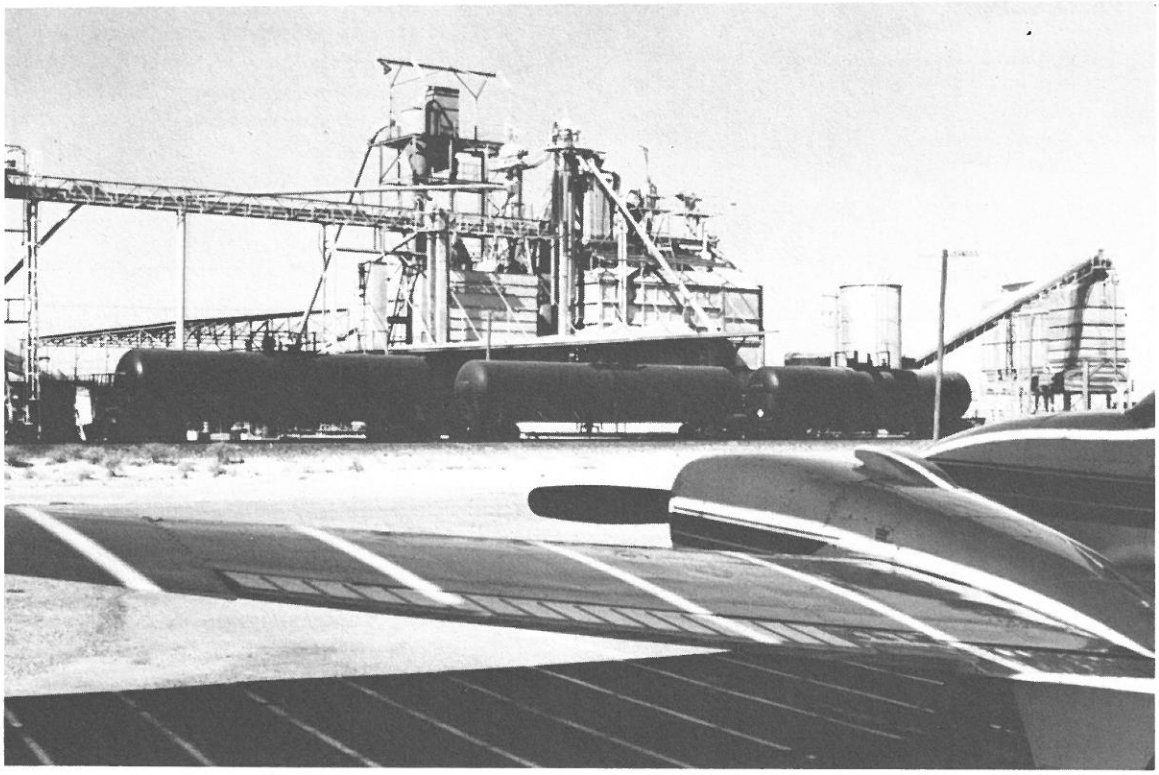
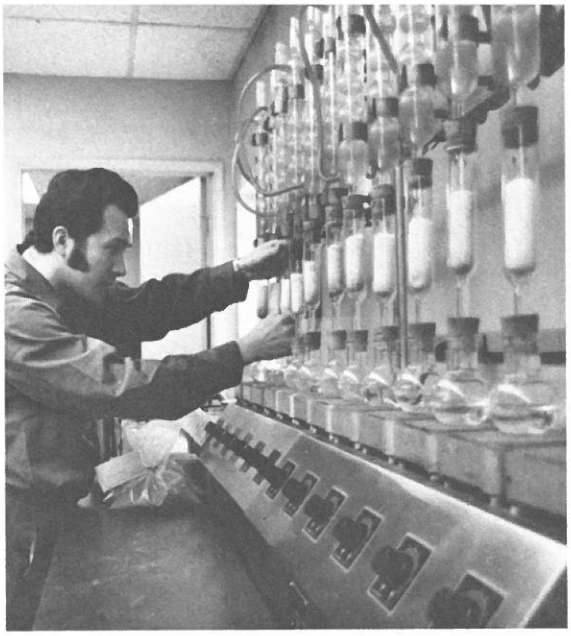


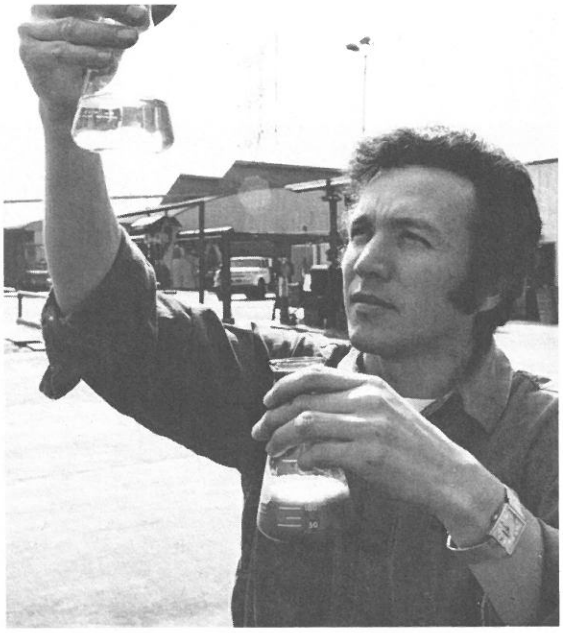


To a large extent, the future sophistication of the rendering industry will be governed by the increasing technological sophistication of the industries that use its products and the demand that those products be "tailored" to the requirements of those industries. More and more the nutritionist and the researcher are setting the requirements for animal protein meals and tallow used in livestock feeds.



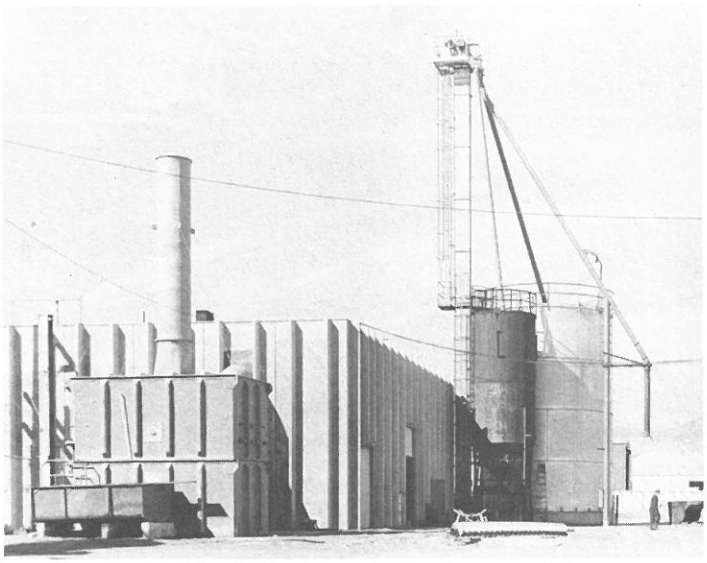
This multi-million-dollar feed mill seen over the wing of the twin-engine executive aircraft operated by the feedlot owner is indicative of the degree of sophistication reached by one of the renderer's customers — a degree of sophistication the renderer must attain if this is to remain a viable market for his finished products.

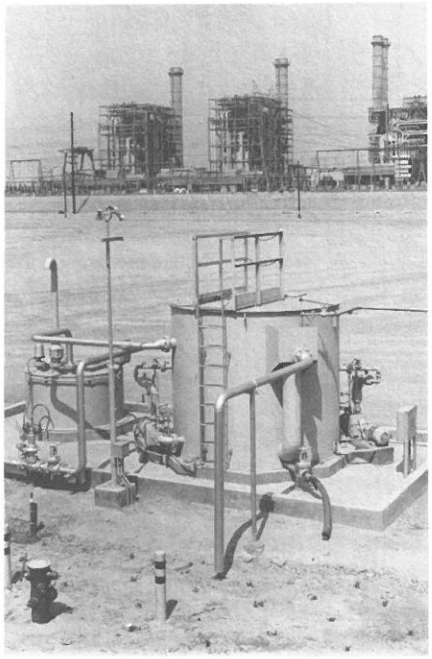




More and more in-house analytical and quality control capability is being acquired by the larger renderer. The amount of this work being bought out by the smaller renderer also is increasing.

By 1980, the rendering industry will have spent some quarter billion dollars on air and water pollution systems like these to meet the ever increasing Federal and local regulations written to protect the environment. While the rendering process does generate water pollutants (the kind which can put a strain on the biological and chemical oxygen demand, BOD and COD) these are not hazardous. It does not pollute the atmosphere in terms of releasing any hazardous or toxic substance. Its only offense in this area is to emit an unpleasant odor at times.





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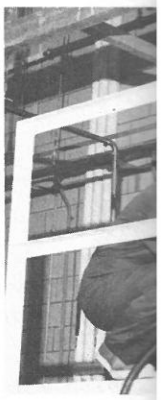
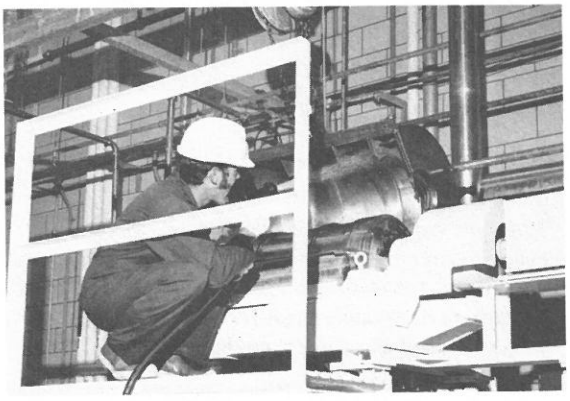
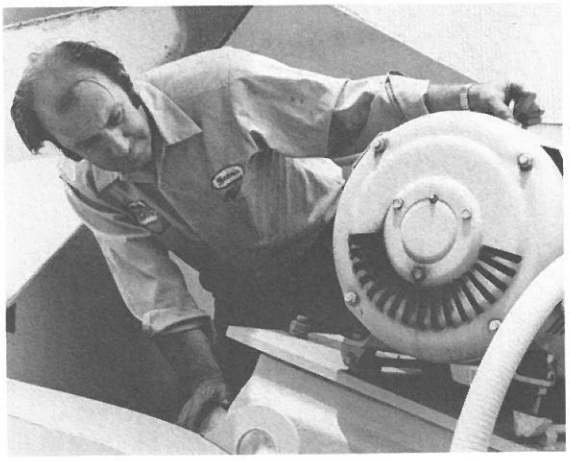
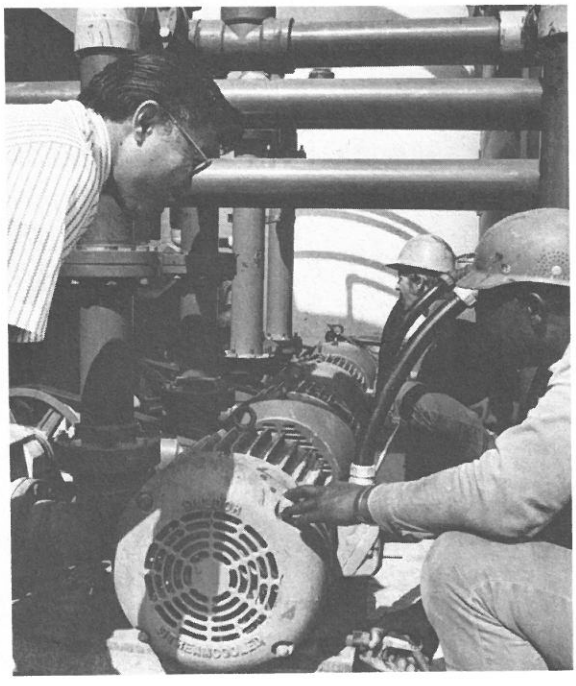


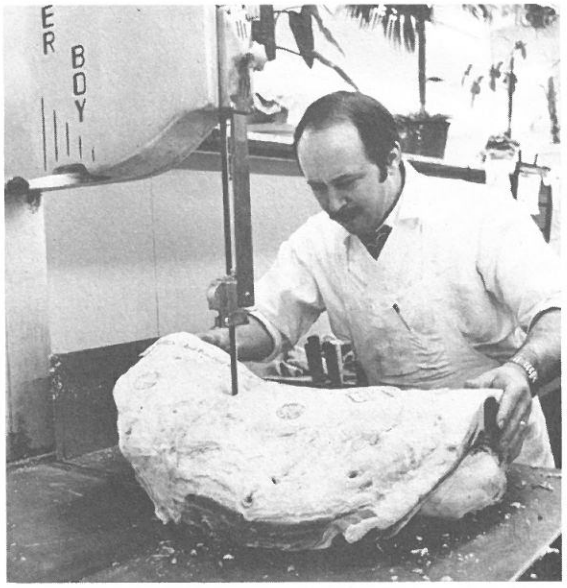
The energy crunch is beginning to pinch the renderer. Many operators today are installing insulated tallow holding tanks such as these which it is reported save some eight million cubic feet of natural gas per year for the renderer.



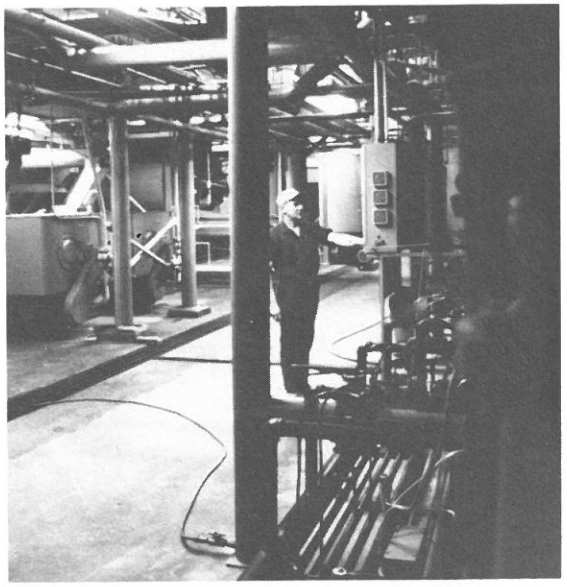


More automation, a greater degree of mechanical and electronic sophistication, cut labor costs, speed up production and improve the product, but they also have their own penalties. One of these which is costly is specialized maintenance which requires more highly trained personnel.

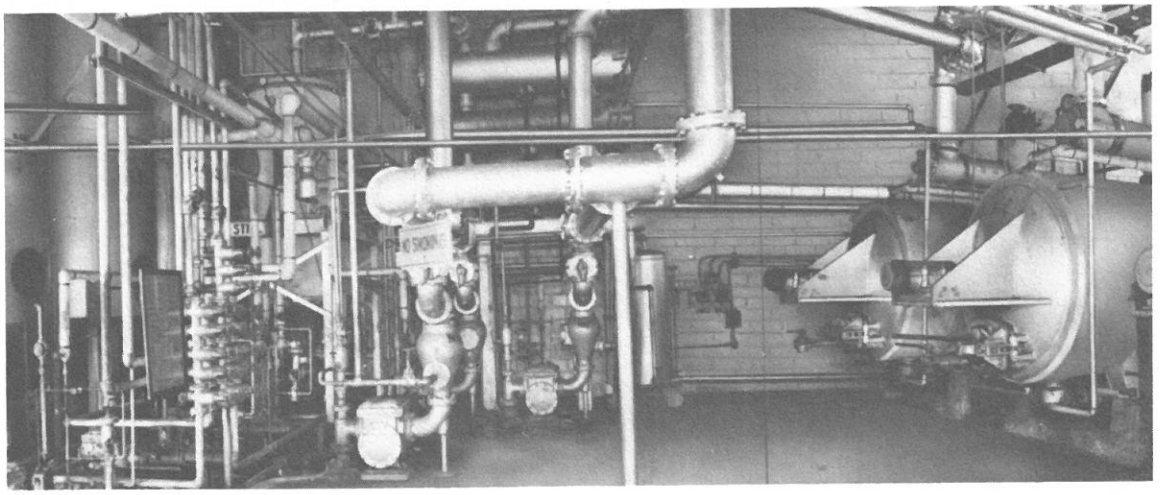




The increased trend toward boxed beef (in which most of the trimming has been accomplished at the initial slaughter house/packing plant level) and new meat grading regulations proposed by the USDA could be a threat to local renderers in many parts of the nation.



You can expect rendering plants to become even more automated and technically sophisticated than they are today. Computer control of inventory already is here and computer control of processing is just around the corner, authorities say.



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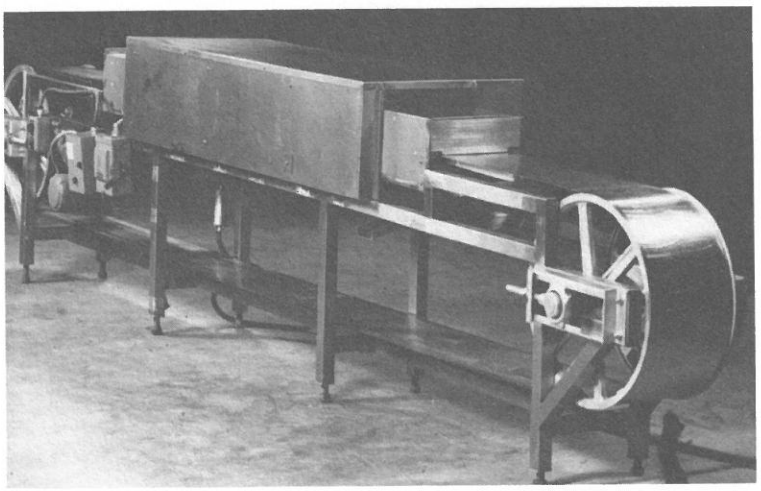
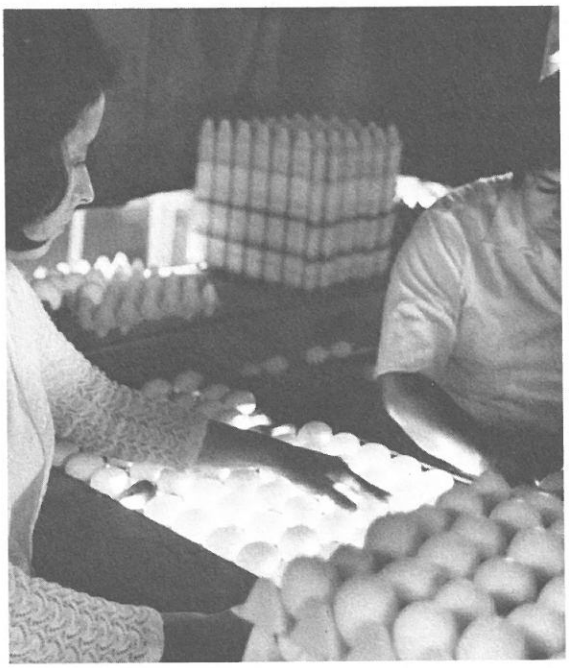
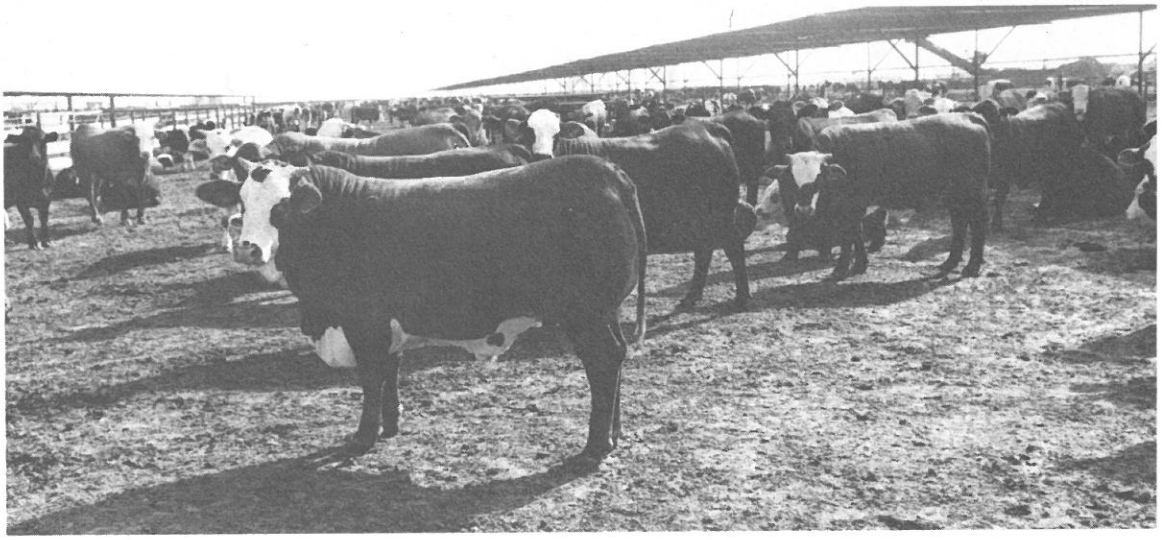
The newest rendering equipment is this microwave machine now being tested. This sub-scale version has demonstrated considerable promise both in improving product quality and in saving energy.



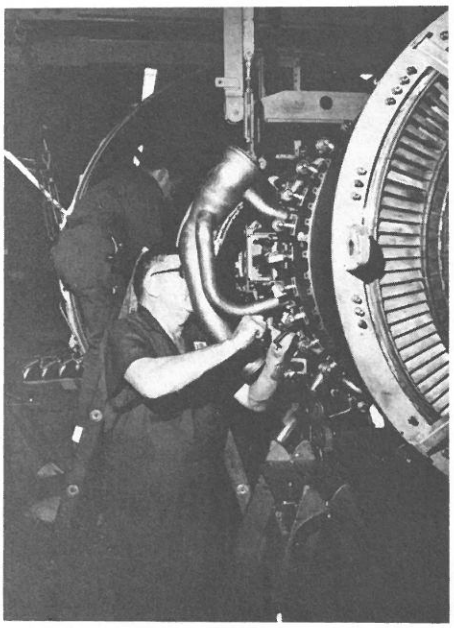


On the marketing side, the future continues to look good for feed fat in cattle and turkey rations and for animal protein meals in broiler, layer and turkey production. More use of rendered products in swine feed is indicated.



Greater use of animal fats by the chemical industry is foreseen. Nearly 650 million pounds was used for fatty acid production in 1977 and the figure is expected to climb.

A major new application for fatty acids, some of them only available from animal fats, is in synlubes which already are in wide use for jet aircraft engines and are in increasing use in commercial vehicle fleets.



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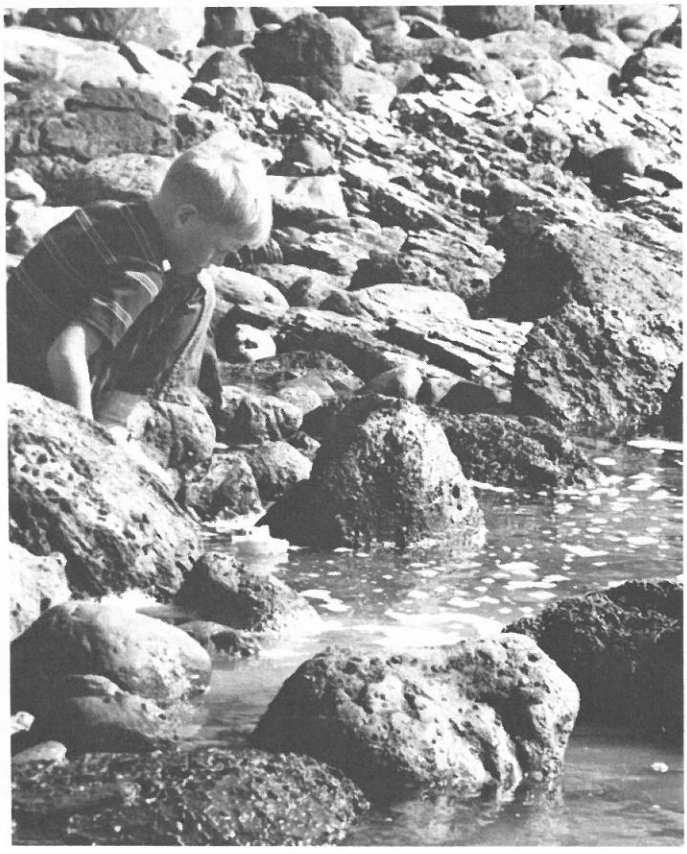
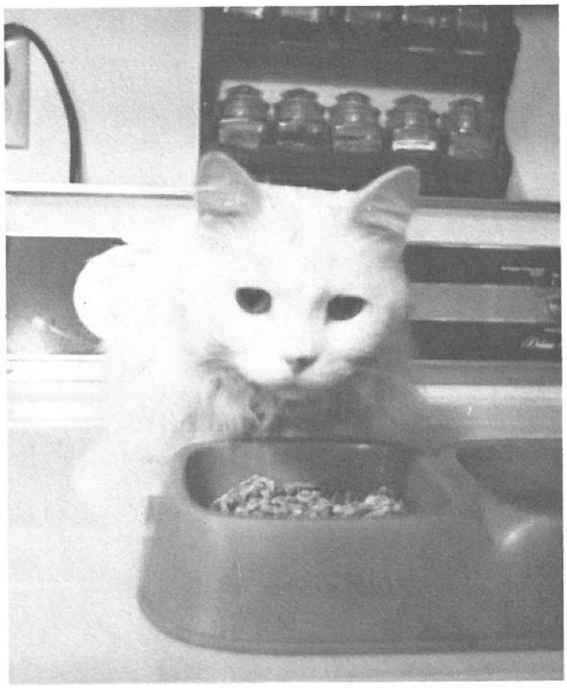


It generally is conceded that continued pressure from environmentalists for cleaner water will decrease the amount of phosphates used in powdered and liquid detergents. Eventually, it is felt more tallow will again find its way into household cleaners.



The pet food market — dry pet food, that is — is expanding rapidly for the renderer.

Also expected to continue to expand is the export market for U. S. tallow and greases.

meets NRC standards." Even if the pet food manufacturers were not concerned with their own product quality, this compels them to pay close attention to the effect of ingredients on the end product.

In terms of what the pet food producer would like to receive, one manufacturer outlines it this way:

"The meat and bone meal we like best for our pet foods is made of a standard raw material mix containing nothing but fresh, clean slaughter offal and added bones, cooked to an end-point moisture content of five to eight percent; resulting in an end product having a protein content in the neighborhood of 50 percent, an ash content of 26 to 32 percent, and a phosphorus content somewhat over 4.4 percent.

"We realize, of course, that many renderers work with raw materials that do not fit this description. You may run slaughter offal alone, or shop fat and bone alone, or may handle dead stock. We do not in any way imply that such mixtures are less commendable than the standard mix of offal and bones. We are simply describing what we like to get for our pet foods."

The pet food industry would like to get meat and bone meal that was made using fresh, unspoiled offal, with all stomachs and paunches opened and emptied, with all intestines hashed and washed, and with minimum hide, hair and trash included.

While hide and hair in a meat and bone meal register as protein, they are low in quality. The hide is a collagen deficient in essential amino acids, and the hair—unhydrolized—is practically indigestible. Furthermore, the hair tends to remain recognizable as such in the end product. This is offensive to the consumer.

The rendering process itself degrades the material being processed to some degree. The degree of degradation is dependent upon the degree to which the material is dried. Neither Kjeldahl proteins nor amino acid profiles reflect the degradation. The nutritional value of the end product can be determined only by feeding tests.

A major pet food manufacturer ran a number of feeding tests designed to measure the effect of the end point of the cook—that is, the degree to which the material is dried—on protein quality. Tests were run on poultry meal, batch-process meat/bone meal and continuous-process poultry meal. In all cases, the results were essentially the same. Over-dried meal loses a substantial proportion of its nutritional value. Furthermore, the tests showed that neither cats nor dogs like an over-dried meal and the more it is over-dried the less they like it.

Feeding tests show dramatically the effect of over-cooking on the palatability of meat and bone meal to dogs. Cats react in the same way to over-cooked poultry meal.

Based on nutritional and palatability results, pet food manufacturers prefer a meat/bone meal that has been cooked to a true end-point moisture content of five to eight percent.

A renderer who has been cooking to two or three percent moisture content for years will find it difficult to change to a six percent end point. The high-moisture end point requires more attention from the operator, the meal presses out somewhat differently and more horsepower is required for grinding; but a renderer who cooks to a true six percent end point moisture content, rather than two percent, not only puts out a better product but also produces at least four percent more tons of product to sell

to the pet food manufacturer.

"What we are trying to do," one manufacturer says, "is convince the renderer that it is a 'win-win' situation. We win by getting better ingredients. The renderer wins by improving his operation and the overall quality of his product."

He observes that the pet food industry might be willing to reduce the current protein requirements for meat/bone meal for a meal that "does a better job." The higher protein ratio in the final product makes little sense if the animals will not eat it and, thus, the housewife will not buy it, he adds.

New requirements like those advanced by the pet food industry are not impossible or even significantly difficult to meet. They do involve higher production costs for the renderer, costs which in many cases the customer initially is unwilling to meet. However, more often than not when a renderer does make available a product essentially tailored to a customer's requirements that customer eventually finds it an advantage to pay a premium and get what he wants.

Perhaps greater resistance to tailoring rendered products lies in the "nature of the beast." All too many renderers—third, fourth and even fifth generation—take the position: "What was good for my grandfather's customers and my father's customers, should be good for mine." Indications are that sooner or later they are going to have to come around or find their customers are dealing with another renderer, one who is more flexible in adjusting to a changing world.

On the surface, one might think that the future looks somewhat bleak for the rendering industry. This most assuredly is not the case.

Rendering has two things going for it that are essential to continued growth of any industry and which will provide the economic wherewithall for this industry to meet and surmount those obstacles presently in view. The renderer's raw material resources, unlike for instance petroleum, are renewable. As the world's growing population is fed, so does the renderer's raw material supply increase. And, not only are existing markets for rendered products steadily increasing, but new markets are constantly emerging.

Further, many of the larger and more progressive rendering firms have recognized that a number of technologies developed in recent years in other areas have the potential for not only improving rendered products but also for increasing production and decreasing overhead. Among them: micro-wave energy, ultrasonics and mini-computer inventory and process control.

In the area of new markets for rendered products, none is more exciting than the accelerating development of synthetic lubricants—synlubes. As previously noted, this new market was recognized as such about 1975 and by 1977 it was possible to begin identifying the magnitude of this market in quantitative terms.

Initially the major oil companies adopted a "show me" attitude when early research reports describing the advantages of synlubes were released. In two short years, that attitude underwent a dramatic change spurred by aggressive research and strong commercial marketing action.

According to Richard Ozimek, president of Ozimek Data Corp., Rye, N.Y., "most oil marketers appeared to believe that Mobil Oil would fall

flat on its face with Mobil I (the first synlube offered in the general automotive marketplace). The attitude was generally, 'Who needs synthetic lubes?' and 'We've done well for a long time without them and we can continue to operate without them in the future.'

"These same companies are no longer that negative. This is evidenced by new market introductions, marketing effort expansions and an increase in technical developments. Mobil I's market success continues to exceed expectations and is spurring activity with synthetic lubricants. Gulf Oil is launching a national test market for a totally-synthetic automotive engine oil. Chevron USA is expanding its marketing coverage and thrust with a synthetic motor oil. Pennzoil introduced a mineral oil/synthetic blend. A totally-synthetic motor oil market introduction in Canada market the 1977-78 winter. Other companies are test marketing mineral oil/synthetic blends in the United States. Every major oil company appears to have synthetic products on the shelf ready to be launched."

Gulf Oil's Marve Campen, an acknowledged expert on the subject, observes that "as new compounds become available at economically-attractive prices, equipment makers can design new machines to take advantage of superior properties of new fluids."

"Such continuing technological advances, as well as ever-tightening government regulations and the decreasing availability of traditional lube stocks will undoubtedly increase the future demand for synlubes," Campen adds.

To better understand the relationship between the renderer and this emerging new market for his finished goods, it is necessary literally to take a "crash" course in oil chemistry. To say the least, it is an extremely complicated subject.

For instance, there still is no universally-accepted definition of synthetic lubricants. For several years, an ad hoc industry group led by the ASTM has worked toward a definition, a system of classification, specifications, tests, etc. Currently, a working definition has been agreed upon—"products which consist of stocks manufactured by chemical synthesis and containing necessary performance additives." The amount of mineral oil used in the formulation as an additive carrier oil is not specified as yet, although it is generally accepted that it should be limited to 10-to-15 percent of the total, finished, compounded synlube.

Campen offers this additional clarification:

"Synthesized base fluids, like synthesized rubbers, are 'man-made' or 'tailored' to predetermined specifications. They are products made by combining (synthesizing) low-molecular-weight components via chemical reactions into higher-molecular-weight compounds. Thus, their molecular structure is planned and controlled and their properties are predictable."

Some people, he adds, like the word "synthesized" instead of "synthetic" because synthesized connotes a "positive process of building up a compound by union of more simple compounds." However, the distinction vis-a-vis synthetic is academic and either term is correct.

There are a number of related compounds that might conceivably be considered synthetic lubricants, so to avoid confusion or misunderstanding, certain of them have been categorically excluded from the working definition of synthetic lubricant. These are: mineral oils and mists of mineral oils; mineral oils plus small amounts of molybdenum disulfide or

graphite; emulsifiable oils; water and "soap solutions," chemical metal working fluids; low-temperature, heat transfer fluids such as summer coolant or antifreeze; solid lubricants and their dispersion non-synlube liquids; plastic films; inert gases; liquid metals or plastics; and exotic natural products such as jojoba bean oil.

Any discussion of synlubes can be expected to contain the terms "synthetic base fluid" and "synthetic lubricant." For all accounts and purposes, the synthetic lubricants can be considered the finished product as it is purchased off the shelf while the synthetic base fluid refers to the major component of that synlube.

For the rendering industry only the base fluids involving the organic esters and the extent to which these organic esters are blended with synthetic hydrocarbons and/or other base fluids is significant. It is the organic esters that are derived from tallow and vegetable oils.

For instance, Emery's Frigid-Go, Eon's E-11 oil and Amzoil synlube are among those using dibasic acid esters or diesters. Eon D-20 and All Proof are among those using polyol esters. Polyalphaolefins—a synthesized hydrocarbon—is the main base stock for Mobil I, Chevron's Sub Zero Fluid and Gulf's new Synfluid. Conoco's Polar Start DN-600 uses alkylated benezene—another synthesized hydrocarbon. It is important, however, to understand that even those base fluids which primarily use synthetic hydrocarbons often include organic esters because of some very specific advantages they offer.

Estimates are that synthetics and quasi-synthetics (mineral oil/synthetic base fluid blends) will develop into a 40-million-gallon/year market by 1988. In that time period the synlube market should equal about five percent of the total automotive, motor oil market.

Polyalphaolefins, polyol esters and di-esters are expected to get the biggest share of the base fluid business in both totally synthetic and quasi-synthetic motor oils of the future. Initially inadequate raw material availability will impede growth of the synthetic lube industry. So the emerging synthetic lube industry will be a boon to fatty acid producers. Synthetic lubes will create a fast-growing and steady market for all the short-chain fatty acids. Prices should stay firm and well above historical levels. It is estimated that the demand for the short chain C-5 to -10 fatty acid will triple to almost 150 million pounds by 1986. All the short-chain fatty acids—C-5 through C-10 can come into play—and therefore a number of manufacturers make up the market. The 1976 demand for all short-chain fatty acids was in the 45-to-50-million-pound range. Ozimek estimates a growth through 1986 of from three-to-five percent a year while other sources put the growth at five-to-eight percent.

Even with his more conservative estimate, Ozimek sees a 1986 shortfall of more than 60 million pounds a year in short-chain fatty acid production, especially C-7 and C-9.

Traditionally, the price of tallow paid the renderer has been a function solely of supply and demand. In recent years detergents replaced a large share of the natural soap produced and the demand for tallow. Tallow for fatty acid production has, on the other hand, increased over the past 20 years from 200 million pounds to nearly 830 million pounds by 1976.

It is expected the cost of synthesizing C-7 and C-9 acids from petrochemicals will continue to be high unless additional technological

breakthroughs are achieved. Plus, the spector of dwindling petroleum supplies and potentially disastrous price hikes for Arab oil, continues to haunt the economy. Since tallow and vegetable oils are renewable resources, it stands to reason even with competition from short-chain fatty acids synthesized from petrochemicals the new demands imposed by the synlube industry will continue to be "good news" for the renderer.

While the synlube market emerged indirectly as the result of research aimed at developing better lubricants, other research specifically directed at increasing the uses of tallow continue to show promise.

The Agricultural Research Service of the USDA long has been a leader in this area. Important recent work involves the fractionation of beef tallow with an eye to increasing the domestic use of so-called inedible tallows in edible end-products and at the same time decreasing the cost of those products and reducing U.S. dependence on imported vegetable oils.

The United States is the most important beef tallow producer in the world. Approximately half of its beef tallow is exported at relatively low prices when compared to other fats and oils. Only about 10 percent of the total is used in domestic edible products.

On the other hand, cocoa butter, coconut oil, palm oil and palm kernel oil are imported oils whose demand for use in food and confectionery products has been increasing over the past few years (the first of these is the most expensive fat in the world).

Beef tallow contains specific triglycerides which also are contained in these imported fats and oils. In the USDA laboratories, beef tallow has been fractionated into products which are compatible with, or superior to the imported fats and oils. It is visualized that products from fractionated beef tallow can be used as substitutes and extenders to cocoa butter, palm oil and other fats and oils in the food and confectionery industries.

To reduce reliance on expensive imported fats, the USDA developed a method to separate certain compounds from beef tallow. One of the resulting products may be used as a cocoa butter replacement since its properties are almost identical to those of the expensive import. A liquid oil, valuable as a food oil for salad or cooking use, also is obtained as a co-product of the beef tallow separation process. Partial hydrogenation of the oil has resulted in a new family of semi-solid fats which require no further fractionation. These semisolid fats have great promise in confectionery and shortening applications. Confectionery, as used in the study, include products such as: solid chocolate, solid chocolate mixed with other foods, panned chocolate and/or confectioners' exteriors, panned chocolate and/or confectioners' interiors, chocolate coatings, fillings and other candy products.

The United States has become a major importer of vegetable fats and oils such as palm, palm kernel, cocoa butter and coconut. In recent years these imported oils have found increasing use in the U.S. food industry and confectionery fats, including hard butters, and as a substitute for cocoa butter.

The high price of cocoa butter and fluctuations in world supply over the past few years have caused most manufacturers to consider cocoa butter substitutes, reformulation and price changes in the production of cocoa products and candy bars.

The imported lauric fats prepared from palm kernel and coconut oil as

cocoa butter extenders have a tendency to develop a soapy flavor upon hydrolysis and are not compatible with cocoa butter. Domestic substitutes have been prepared from fractions of hydrogenated cottonseed and soybean oils; however, they may be only partially compatible with cocoa butter and sometimes develop rancidity. A third type of cocoa butter substitute, by fractional crystallization of palm oil and blending with a fraction of either Shea or Illipé butter marketed in Europe, has glycerides similar to cocoa butter but has restricted use as a cocoa butter extender.

The fractionation of beef tallow yields one product with melting characterstics which resemble cocoa butter. In fact, fractionated beef tallow may have an advantage over cocoa butter since changing the parameters of the crystallization or by blending of fractions, confectionery fat of various melting ranges can be produced.

USDA engineers have completed preliminary cost comparisons of alternatives for producing fractionated tallow. These cost comparisons were based on a preliminary conceptual process (a process with no actual pilot plant data available). These initial cost comparisons indicate that the products which result from beef tallow fractionation can compete economically with cocoa butter and other vegetable oils in the food and confectionery industries.

We observed how in the 1950s the advent of the synthetic detergent dealt a near crippling blow to the rendering industry since, up until that time, the major market for tallow was in the manufacture of soap. With the 1970s and the age of environmental activism, the polluting characteristics of petroleum-based detergents were recognized. The Environmental Protection Agency and a number of individual states began taking action to reduce the amount of phosphate pollution being channeled into our lakes and streams. This caused no little concern among the detergent producers and spurred research by the USDA into finding a way for soap producers to return to non-polluting, natural ingredients such as tallow.

Key to any changeover from petrochemicals to tallow-based detergents has been the tendency of natural soap compounds to form curds in hard water. Much of the water in this country contains large quantities of minerals. The level of these minerals in the water determines the hardness and directly determines the effectiveness of soap compounds. The curd, which the housewife will recognize as the "ring around the bathtub," technically is known as lime soap. The research by the USDA augmented by additional independent research conducted under the auspices of the Fats and Proteins Research Foundation (supported by funds from the National Renderers Association) primarily has been directed toward finding a means to eliminate the curd yet maintaining the basic effectiveness of soap as a cleaning agent.

Discovery that certain surfactants would modify the lime soap led to the formulation of a lime soap dispersing agent (LSDA). Additional research resulted in development of a complete detergent compounded primarily from tallow with LSDA and a small amount of sodium silicate. This detergent features 65 percent natural tallow whereas a typical synthetic detergent may have a 20 percent petrochemical base with 50 percent phosphate "builder."

According to the USDA, the "high detergent natural soap formulation

contains 85 percent rapidly biodegradable, environmentally-safe components and 15 percent innocuous ingredients whereas the synthetic formula is 70 percent anti-environmental, with slow and incomplete biodegradation and eutrophication tendencies."

USDA research objectives were to retain the plusses in tallow soap while overcoming the three negative features in hard and cold water. The new soap had to equal synthetics under all washing conditions in modern washers with all kinds of fabrics, while retaining all its inherent safety characteristics.

In comparative tests cotton and cotton-polyester blend fabrics were washed 25 consecutive times in hard water. Soap alone caused greasy lumps of lime soap to deposit on the fabric. Carbonates caused encrustations on the fabrics. The modified soap formula like the high phosphate detergent did not cause any buildup of foreign matter on the washed fabric. Scanning electron microscope studies were made to substantiate these findings. "Bundle tests" were conducted by several soap companies and these further confirmed the laboratory results. Toxicity studies for the modified soap formulations were run and showed that the new detergent is non-toxic to humans and animals, is readily and completely biodegradable, is non-toxic to fish and has no effect on algae.

The new soap-based detergent was introduced commercially into Japan under a cooperative program and after two years demonstrated considerable acceptance. Still progress has lagged in this country. The principle obstacle remaining to general acceptance of the new detergent is the huge capital investment the major producers of soaps and detergents have in their plants and equipment. There simply is not sufficient soap-manufacturing capacity in the U.S.

When the big switch to detergents came the manufacturers literally put all their eggs in one basket with the synthetics. By and large, a capacity to manufacture natural soap was retained only in the bar soap area while hundreds of millions of dollars were invested in facilities to produce synthetics for the laundry market. It is going to take strong combined pressure from both political and economic considerations to bring about a switch back again.

While this move still is somewhat in the future, a number of experts see it as becoming a reality and further expanding the market for animal fats and oils.

Existing markets continue to grow. Use of feed grade fat by the cattle industry creeps upward. Feed fat also is in wide use by turkey and broiler producers. Animal protein—in this case meat/bone meal—has been "discovered" by the hog raiser. And, of course, its use by poultry ranchers for both broilers and layers continues at a very high level. Notwithstanding the huge share of the soap market held by synthetic detergents, use of tallow for bar soaps continues to grow in phase with population increases. In all its aspects, the market picture for the rendering industry is excellent well into the next century.

Throughout the 1900s, application of automation moved slowly but steadily to the point where today it plays a major role in virtually all large rendering facilities. Considerable manual labor still is expended by the smaller renderers throughout the nation, particularly the rural renderers. However, automation itself isn't sufficient to help the modern renderer

meet the challenges presented by escalating labor costs; the demand for more finished product tailored to specific consumer requirements and guaranteed to meet those requirements; the growing energy crisis and the need for increasingly stringent air and water pollution control measures. Application of technologies born of the space age is required and a beginning has been made in this direction.

What could become the most important development in rendering technology since the pressure vessel took the place of the tallow pot was unveiled for the first time publicly at the National Renderers Association annual convention late in 1977.

Leslie Bird, president of Superior Fabricating Co., Fort Worth, Texas, described and provided visual documentation on the initial tests of a microwave rendering system conducted at the Vernon Calhoun Packing plant, Palestine, Texas.

Introducing Bird, Bill Prokop, NRA director of Engineering Services, said the system "represents a large potential for saving energy in the rendering process."

A working renderer familiar with the system, Millard McAfee, general manager of Beatrice Foods' San Angelo By-Products plant in Texas, offers this description.

Electrical energy is transformed into electro-magnetic energy or microwave energy by a tube called a magnetron. Essentially, this tube is like a broadcsting station sending out waves of high frequency energy into the cavity of the microwave oven. Microwaves bounce off metal surfaces much like light is reflected by a mirror so the energy is beamed into the oven, bounces around and is absorbed by the material to be cooked.

This microwave energy agitates the molecules in the material to be cooked. The agitation produces friction which in turn generates heat. The heat generated within the material itself causes it to cook. Because all the heat is produced in the material none is wasted in pre-heating the oven and none is required to maintain oven temperature. The principle is that simple.

The machine described to the NRA is a sub-scale device operated at a rate of 15 to 30 pounds of raw material per hour. It can best be called a development prototype and primarily is intended to validate the operational concept.

Of all stainless steel construction, including the stainless steel belt which in itself is considered a fabrication breakthrough, it has a minimum of moving parts and operates entirely on electrical power. For the prototype tests, raw material—ranging from first class edible fat to blood, paunch material, turkey heads, whole deads (except for paunch and head) and a combination of feathers and blood—was prepared on a custom basis. Fats, for instance, were ground to the consistency of hamburger or sliced into pieces about the shape and thickness of a human hand. Tests showed that in processing edible fat, the hamburger-sized grind (1/8 orfice) yields the most tallow while the sliced raw material provides the best tallow.

Obviously, a unit operating at 30 pounds an hour and requiring custom preparation of the raw material does not represent any commercial application but, in the opinion of Dr. Wayne A. Lapori of the Texas A & M Engineering Department, the test conducted by him at the Calhoun plant

did validate the concept and also provided valuable data with which to continue to the next step in the development program.

That step is construction of a unit capable of handling 3,000 pounds an hour is being fabricated. It is being placed with a small South Texas edible rendering plant. Here raw material will come directly from a Reitz grinder. Exact finishing steps taken with the tallow and crax will depend largely on how the unit works out in this pilot-plant project.

Understandably Bird is excited about the potential of his machine which already has been more than a decade in development.

"They said we could not do it," he says, "but we have. It works and it produces a tallow far superior to anything on the market today."

Bird's enthusiasm and Lapori's test results notwithstanding, many renderers remained less than convinced that the microwave rendering machine was much more than a toy. They were not, however, exposed to an evaluation of the concept and the machine by the working renderer who had it in-plant for six weeks and who became as enthusiastic about it as its developer.

Millard McAfee, while allowing as how the results of the upcoming pilot-plant operation will be the determining factor in terms of future application, is in agreement with the statement that microwave rendering could prove to be the most important development in the industry in a hundred years. He looks at it this way:

"Gas and oil—the energy people say we are going to run out of these fuels in the 1980s. Conversion to coal is going to cost a lot of money. Coal-fired steam systems could cost as much as a whole rendering plant. Coal also presents another pollution problem, not only to us but to the power companies. When the power companies convert to coal they are going to have to significantly increase our power rates but electrical energy still is going to be cheaper than coal. As far as gas is concerned, our rate already has increased 1,000 percent—electricity only 300 percent. Also small steam plants are very inefficient.

"For some time we have been looking at ways to go all electric. We have considered hot oil to run our melter. The plastic industry has been using hot oil for some time to heat their extruder nozzles. They can develop about 400 degress. But for us the technology also presents other problems.

"After looking at the microwave rendering machine for more than a month, I think it can be sized up to do the job. Sure, there are a lot of things to work out. The big obstacle is sizing up the magnetron. Bird says he has that licked.

"One of the obvious advantages of this system is that it eliminates entirely the need for any other source of heat. Three 30,000-pound ovens, for instance, can provide enough heat for steam and all other plant uses strictly as a by-product of the rendering process."

Assuming the pilot-plant operation does prove out the validity of full-scale microwave rendering, what do we have?

- A system which will cost about the same as a state-of-the-art continuous dry rendering system of conventional design.
- A probable significant saving in maintenance. There just isn't much to go wrong.
- The capability to go all-electric. A large renderer could even install his own emergency electrical generating plant and be safe from power out-

ages.

• Elimination of all conventional steam-generating equipment and the attendant maintenance and operating costs.

• Probably a much higher grade finished product with fewer interim processing steps.

• A considerable reduction in labor costs—maintenance and operating personnel.

Dealing as it does with finished product in the millions of tons, the rendering industry is well aware of the problems of inventory control. Here is another area in which advanced technology finally is being applied. The first commercial application of ultrasonic measurement devices feeding data to a mini-computer system came in 1978 at the Vernon, California, plant of Darling-Delaware, a renderer of national magnitude.

The system, provided by Inventron Industries of Los Angeles, represents a first in the rendering industry. Ultrasonic level measuring systems have been applied to other industries which require real-time measurement of fluid levels in storage tanks, conduits, etc., but not to rendering. It was accomplished at the California facility by consulting engineer Gene Keefner, who holds exclusive rights to the application of Inventron material inventory systems to the rendering industry.

The ultrasonic system consisting of a transducer mounted in the tank or silo being measured, an electronic controller and a remote panel display which provides readout in digital and analog form, does away with probes, floats, arms, levers, etc., required in conventional measuring systems. The level of the material is determined by the sophisticated, ultrasonic echo-ranging technique (not dissimilar to advanced electronic devices used to detect and determine the course and speed of submerged submarines). The signal initiated by the sensor bounces off the material. The system measures the time lapse for the signal to get to the material and return by calibrated electronics. This is displayed as a voltage proportional to the level in the tank or silo. The units are temperature-compensated to correct any errors induced by changes in sound velocity caused by changes in temperature. There are no moving parts to become gummed up and jammed or that require cleaning and regular maintenance. The system as installed initially will be used on a response basis; that is, it will provide the measurements at the request of manangement (the push of a button). Inventory levels will be taken not only on the meal storage silo and five tallow storage tanks but also on the two days-run, tallow tanks and two raw grease storage tanks. The system has the capability of delivering data on a continuous basis directly to a computer.

Although the initial application of mini-computer process control to rendering is being accomplished in Europe, it is being accomplished by a combination of U.S. companies—a major supplier of rendering systems and a major computer firm. There can be little question but what its advantages in terms of quality control, reduction of labor costs and increased production will cause American renderers to follow suit.

While availability of capital and the potential of advanced technology should stand the large renderer in good stead as this industry continues to grow, there is a whole lot of pessimism about with respect to the future of the small renderer. The general opinion seems to be that the small renderer is on the way out; that he cannot resist the financial pressures

brought about by the need for huge capital expenditures necessary to meet air and water pollution regulations and that he isn't in a position to upgrade his plant and equipment so as to produce the higher quality product now being demanded by consumers.

There is one small renderer who doesn't buy this prediction of doom. Charlie Helms, who does business in central and northern Washington, says:

"If a renderer goes down the drain, it usually is his own fault."

Focusing in a little closer on his own philosophy, Charlie adds:

"They lose sight of the real reason for the rendering industry—service. Without the renderer the world would be inundated in piles of cattle offal, chicken guts and fish heads. Environmental service is the principle contribution of the rendering industry to society but we tend to get product oriented rather than service oriented. As rendering becomes big business we lose sight of the real reason we're here."

Helms, who calls himself "one of the real, old time renderers, one who likes what he does," certainly is service oriented. You might say he is the clean-up man for northern Washington, serving an area from Seattle north to the Canadian Border picking up an average of 1,500 head of deads a month, four million pounds of fish material a year, crab and oyster shells and just about anything else that can be rendered. Up to 100 fishing boats and two large canneries producing 120,000 pounds of fish waste a day depend on A & M By-Products. In addition, Helms has developed a sizable kitchen grease business.

Unlike many small renderers, Helms doesn't object to the fact that the large renderers in the area pick up the "cream" of the raw material available—the slaughterhouse, packing plant and butcher shop scrap.

"That's just the natural relationship between the big renderers and the little ones," he says, "they need us—although they don't always seem to understand this—to clean up all that material they don't want and can't really handle."

Helms is no newcomer to the rendering industry. He got involved in 1938 at age 16. Today, Helms runs a five-cooker batch plant using, he jokes, "nearly everybody's equipment."

"I even have an old Number 1 Anderson Expeller®," he adds.

Handling fish material tends to lead to a lack of continuity of employment for the men who operate a rendering plant but Helms has overcome this problem with some innovative thinking and methodology. Major catches in that part of the country include salmon, where the season is unpredictable (in fact, it is set by regulation); herring, which comes in December and lasts until March; hake, which is available from February to May; and bottom fish (flounder, scrap fish, etc.), which comes in the April-May-June period.

Fish also require special handling in that each fish has a different consistency and the amount of oil varies. The amount of oil also varies depending upon when the fish is caught, early or late in the season.

Helms separately pre-cooks each type of fish for a pre-determined time when it is in season and stores it segregated by type in his warehouse. Then, as needed to supplement dead stock and other raw material at other times of the year, it is removed from storage and the cook is completed.

Finished product, both oil and meal, is merchandised locally—within

50 miles—for livestock rations. Fish oil is blended with animal oil producing a feed fat (used primarily for dairy cattle) that is higher in energy than straight animal fat, according to Helms. It is sold strictly on a "btu basis." At any given time Helms has some 500 tons of pre-cooked fish material warehoused for use whenever supplies of other raw materials are slack.

That Charlie Helms is an innovator is evident in other ways. He was one of the pioneers in production of feathermeal as a fertilizer.

For 18 years he has engaged in a cooperative training program with the local high school providing a source of trained plant operations people for rendering and meat packing firms in the area.

With the advent of the energy crunch (he found his gas bill, which was $700 a month when he started, topping out at $13,000 a month) he converted to auto drain oil and established an adequate supply for his needs.

"Waste oil was looking for a market, I was looking for an alternate source of fuel, it's that simple," he says.

At the time when many small renderers are concerned about how they can hang on, Charlie Helms displays a lot of faith in the future. He bases that faith on two conclusions:

"The little guy can live by his wits and his integrity.

"The little guy can secure his future if he is willing to provide a service."

To many, Helms may appear as an anachronism in this age of high technology and big business. But, then again, his approach may well be the answer for many of the small renderers who now and in the immediate future feel that the transition in process within their industry is more than they can handle. Certainly, the clean-up role of the renderer represents one of the industry's major contributions to society and that role can only become more important with each passing year.

Summing up what the coming years hold for the renderer from the vantage point of the late 1970s we find:

- although there apparently will be adjustment from some geographical areas of the country to others, the raw material supply should be adequate throughout the foreseeable future;
- advanced pollution control technology and a greater awareness on the part of regulatory agencies and the public that the rendering industry does not contribute to a health hazard but occasionally constitutes a nuisance will permit the industry to continue to do business—but it will be expensive;
- new technologies—particularly use of microwaves—appear to offer great potential when it comes to coping with the shortage of energy;
- existing markets for rendered products continue to grow; old markets show signs of returning and new markets constantly are emerging;
- more and more renderers are coming to the realization that the past is just that—the past—and they can continue in business and prosper by adjusting to the demands of today's society;
- the role of the smaller renderer remains secure if he makes the most of the ever-increasing need for his services as the clean-up man in the food chain; and
- the invisible industry will grow more and more visible every day as society recognizes that its many contributions are essential to the day-to-day maintenance of the quality of life.

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